JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

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EDITORIAL NOTES—GAS, &c.

Projected Gas Legislation under Review.

WITH this the first number of the "JOURNAL" for the New Year, the review is commenced of the gas legislation that is proposed for the coming session by those responsible for the conduct of the gas undertakings concerned, both company and municipal. One of the special efforts made by us is to present readers with a complete account of the parliamentary work, session by session, from introduction to finish; and this is necessary if one is to keep in touch with change and developments during the session, and to properly appreciate the parliamentary trend in connection with the affairs of the gas industry. As has been previously remarked, the coming session does not promise to be big with interest in gas matters whatever it may be politically. But promise is sometimes defeated by unexpected happenings. In one direction, we had looked for interest; and that was to see what kind of reception Parliament would accord the Salford Bill, and the scheme for profit appropriation that it had been understood had been drawn up in the endeavour to appease the outside authorities who were victorious in the session of 1909. But the Bill is reported to have been dropped again—at all events, for the coming session. As to the reason, there is no information; but surely a municipal authority of the standing of the Salford Corporation ought to show a little less vacillation over their parliamentary schemes than has been the case of late.

The Bills that form the subject-matter of the first instalment of our review are the promotions of companies that desire transference to full statutory condition. About the measures there is nothing much other than detail to which attention can be drawn. It is, however, a noticeable feature of these small gas undertakings that the majority stand in striking superiority to the small electricity concerns. Week after week one reads of the financial weakness and straits of the latter, more especially in the circumscribed residential areas where the opportunity for expansion is not great; while these moderate sized gas undertakings that submit themselves as fit and proper concerns for carrying parliamentary privileges and obligations are mostly showing a good result for those who have invested capital in them. The expansion of business, and the desire to alter the boundary lines of areas of supply by taking in at present unoccupied ground, are very noticeable points in reading the preambles of the Bills; and Parliament has never refused propositions for expanding good service on the part of a gas undertaking where there is advanced a tenable case, supported by a good character. But in framing their Bills, we would strongly advise these smaller companies not to voluntarily place themselves under limitations that are not insisted upon, which will in any way affect the freedom that is so necessary in competitive business. For instance, there is no reason whatever why any company—one among those in the Bills reviewed this week does so—should define maximum discounts for prompt payment and large consumption, and thus place themselves under restriction, while a simple extension of section 13 of the Gas-Works Clauses Act of 1847, which only binds to equality of rebate under like circumstances, will satisfy Parliament without specifying any limitation. Nor can we understand why a company should want to limit the length of contracts entered into for gas supplied for public purposes within the area of supply, to a maximum term of seven years.

Stand-by provisions on the models of both the Heywood and the Mountain Ash clauses appear in certain of the Bills under notice; but we have a decided preference for the former so long as the latter does not contain provision in respect of gas "stand-bys" to electricity supply, which are found to be so useful in the event of failures of the latter. Touching electricity, two of the measures incorporate requests for authority to apply for Electric Lighting Orders, and a third asks direct for electricity supply powers. A much (in our opinion) neglected provision is included in the Chapel-en-le-Frith Gas Bill. It is the one that empowers a Company to offer issues of stock or shares to consumers and employees of the Company before submitting them to public auction or tender. Incontestably, it is a good thing to get consumers and employees to have a financial interest in the concern. A growing disposition is observable on the part of promoters to provide for audits being conducted by professional men, who are not required to be shareholders. In most of the measures, too, is the now common provision limiting the divisible profits carried forward to a sum not exceeding one year's dividend at the authorized rates. The criticism might be passed on the Sidmouth Gas Company's dividend proposals that they are rather complicated. In connection with the Ashborne Bill, the Company appear to have two standard prices—3s. 9d. within a defined area, and 4s. 3d. beyond. As the clause is worded, it seems that the difference of 6d. between the two prices will always have to be maintained, and that there must be a uniform reduction or increase of price in the inner and outer areas on all occasions, to enable the sliding-scale in respect of dividend to be exercised. Would it not be better to take the lower price as the standard on which movements of the dividend are to depend, and protect the consumers in the outer area by naming the maximum difference that may exist between the prices in the inner and outer areas? Such an arrangement would give greater elasticity.

Utilization of Coke-Oven Gas.

WE have laughed before, and probably shall laugh again, at the schemes of the enthusiasts for the distribution of gas and electricity through large areas from the pithead. Yet, while we laugh, students of the movements of economy through the victories of Science, and of the gradually increasing successes attained by the application of what Science gives, must admit that what looks like the insertion of the thin end of the wedge to the realization of the dreams of Siemens and many others is found in the utilization of the gas from coke-oven recovery plants for the supply, for ordinary gas purposes, of small communities in the neighbourhood of the coke-ovens; and who can yet say where the limits are placed to the practicability of the schemes? Several villages are supplied in this country from coke-oven plants. At least one gas undertaking purchases gas from coke-oven owners for general supply; and there is the Little Hulton scheme to which Parliament has given sanction, and which scheme is under the supervision of Mr. Ernest Bury, whose eminently practical character in industrial work juts too prominently for any one to think of placing him among dreamers and visionaries.

The potentialities of this incipient utilization of what has hitherto been but waste under the dominion of crude and wasteful plant and cruder methods, we can all recognize as being large; but at this expression it is safer to stop lest we trip into unprofitable prophecy regarding the unknown. The quantity of good gas that is available from the coke-ovens is great; and any success in its distribution and utilization is not going to make permanent home near only to the coke-oven plants. This is seen by what is being done in Germany. Our cousins across the North Sea cannot by any means be accused of being an uneconomical and wasteful nation; and if the good gas of the numerous coke-ovens in the several coal-basins of that country can be turned to useful account, to useful account it will be turned. Paragraphs that have appeared from time to time in "JOURNAL" columns have shown how, from very small beginnings, there is in Germany a gradual growth of the utilization of the coke-oven gas to something that is getting really substantial. The isolated paragraphs pointing out the fresh ground upon which coke-oven gas has entered do not, however, properly portray the actual state of progress. But an article that has just appeared in the "Engineering Supplement" of

"The Times," and from which extracts are published elsewhere in this issue, does more to bring the progress into focus. It is seen that town after town in proximity to large coke-oven plants is taking the gas, and in some cases has shut down, or is in the immediate future shutting down, the ordinary gas-producing plant. This fact exhibits a large confidence and a measure of satisfaction on the part of the gas authorities that we cannot dismiss with a mere "pshaw!" Where is this expansion of utilization going to stop? No one can say. Distribution costs, it may be supposed by some, will bring into close quarters the economical advantage; but against the gas distribution costs there have to be set the carriage on coal and the labour costs incurred in delivering it for the local manufacture of gas. When we find that in one case—Barmen—a contract has been entered into, for no less than twenty-five years, for the supply of coke-oven gas, and that the town is thirty miles from the source of production, we may again ask where, in respect of distance, will the practicability be ended by uneconomy? The cost of conveyance—including interest, depreciation, repairs, and establishment charges—is equal to 3½d. per 1000 cubic feet; and this has to be added on to the cost of gas, which seems to vary from about 1s. to 1s. 3d. per 1000 cubic feet. In other towns it runs down from these figures to 8½d.; and in the case of Little Hulton, it will be 7d.

It is on the price at which the gas can be delivered for distribution that the whole question of economical practicability depends. Most of the German towns that are taking the coke-oven gas are comparatively small; and the expenses of gas manufacture in an ordinary plant in such places would be greater in proportion than the expenses in ordinary gas making and distributing to a large concentrated population. In such cases, there is little doubt, taking manufacturing cost of the gas, conveyance, expense of protection against variable output and interruption (in other words, the cost of ensuring continuity of supply), that the time is far off when the present method of coal conveyance and local carbonization could be economically and wisely superseded by coke-oven gas. It would be no economy to a community to pay more for the delivery of gas from a distance than the price at which it could be manufactured locally; and economical production in gas-works has been going ahead of late, and the economy, or at any rate a considerable part of it, will penetrate down to the operations of the very smallest undertakings. In view of this, in view of the uncertainties surrounding production—the uncertainty of continuity and of quality—in view of the necessity for stand-by local plant to fill in any interruption of the supply, some of the German contracts strike us as being rather long; and there must have been a large amount of courage and a very strong conviction to induce the gas authorities to enter into them. However, there are many wise heads and not easily dissuaded minds at work on this matter; and as the writer of the article in "The Times" says, it would be unsafe to regard the eventual realization of widespread utilization as chimerical or even doubtful. There is a growing waste of good gas through coke-oven expansion and improvement. In the Ruhr basin alone—one of a number in Germany—it is computed that the yearly wastage of gas represents nearly 70,000 million cubic feet; or about 30,000 million cubic feet more than the three London Companies sold in 1909. This waste, human ingenuity will try to put an end to. The extent of the success will—it cannot be otherwise—mark advance in the world's economy.

High-Pressure Gas in Industry.

THERE have been several references of late in these columns to the cultivation of the application of gas to industrial operations; and the mere fact of somewhat frequent allusion to the subject points to the spreading interest that is being taken in it by those responsible for the commercial well-being of gas undertakings. For range of service in industry, high-pressure gas, of course, offers greater benefits than low-pressure gas; but there are comparatively few districts at present where a general supply of high-pressure gas is available, as in parts of London, the suburbs, and Birmingham. But small, comparatively inexpensive, and cheap-running compressing plants can be obtained for independent installation on industrial premises; and the cost of compression by them in relation to the valuable working advantage and the time and workshop economy may be regarded as infinitesimal.

In an article by Herr F. Messinger, Gas Inspector of Charlottenburg, which has appeared in our German contemporary, he has called attention to the usefulness of small independent compressing plants in factories and workshops; but he, like others who have made a study of this matter of the application of high-pressure gas to industrial objects, shows us pretty clearly, by the lines of his advocacy, that the advantages of high-pressure gas may be easily annihilated by the use of improper accessories. The *raison d'être* of high-pressure gas for industrial purposes is the range of temperature, the range of regulation, and the facility with which any temperature within limits may be reproduced; but without suitable appliances all this advantage may be largely destroyed. Even what at first sight appears to be the small matter of the checking of the flow of high-pressure gas at a tap becomes very important when examined and actually. It is essential that the pressure should be maintained right up to the point of combustion, as, if the pressure between a tap and the nipple is reduced, it is quite conceivable that the supply might become no better than a low-pressure one. What is wanted is something which controls the rate of flow without diminishing the pressure. Such an arrangement is said to have been devised by Dr. Fink, of Berlin, in what he terms a regulating nipple. This, however, only as illustration of the care required to obtain the full advantage of high-pressure gas in industrial operations.

Besides the industrial advantage from the application of high-pressure gas, its presence in a large establishment is useful for securing the greatest lighting efficiency from the gas used. Herr Messinger speaks of high-pressure gas as effecting an economy over low-pressure gas for lighting purposes of 50 per cent. If the author bases the economy on the lighting efficiency per cubic foot of gas consumed, we can go even better than that, and point to an increased efficiency of upwards of 100 per cent. per cubic foot of gas by the use of high as compared with low pressures.

Coalite Mystery.

THERE is a great deal of mystery about the proceedings of the Directors of the British Coalite Company at the present time. Perhaps the Board of this venture are not devoid of humane feelings, and preferred to surround Christmas with mystery rather than give the shareholders a shock by telling them the true story of the negative results of the past year, and of what appears to be inevitable, so far as the technical and the commercial aspects enable us to judge. The shareholders met last Thursday; but they had been advised beforehand that the meeting would be a pure formality to comply with the Companies Clauses Act, and that there would be an adjournment to March 30. Sir William H. Preece essayed to keep up his *bon diable* character by wishing the shareholders the compliments of the season in their personal capacity, and said he wished he could do the same in their financial capacity—a wish that undoubtedly found fervent endorsement in the breasts of every shareholder present who was attracted by the beating of the big drum by adept drummers some three years ago. Sir William Preece proclaims himself as firm as a rock in his confidence in the undertaking. He must be the arch-optimist of the concern, if the record of the past twelve months has not done something to take the stiffening out of his oft-expressed confidence in the possibilities of this par-carbonized coal system.

Although the postponement of the meeting was resolved upon under the advice of the first legal authority, the reason for the step adduced does not appear to be a very strong one. It was said by Sir William that important negotiations are in progress, which will materially affect the interests of the shareholders generally; and therefore it was inadvisable to make any statement at present, in case, by so doing, the negotiations (which were well in hand) might be prejudiced to the detriment of the shareholders. It was also intimated that the negotiations will materially affect the future policy of the Company as well as its financial position. All this notwithstanding, the negotiations, being uncompleted, do not refer to the past year's operations, but to those of next year. And surely without touching the negotiations, the Chairman could have found abundant material from which to construct an address touching on the year's events now closed, without sending the shareholders empty away. Let us see. There is the sale of the Hythe plant or a large part of it to a dealer in old iron, there are the commercial results at Plymouth, the shutting-down of the Barking plant, its recent partial starting after the winter's fuel purchases had been made, the failure of the offer of free plants to gas undertakings, the economy and financial advances of the latter under high-temperature

carbonization, the story of the success or otherwise of the Coalite debenture issue, the feeding of London and the country with coalite, the character of the coalite produced, the continued metamorphosis of the plant from the original, and so on. There was no end of material available without trespassing upon the unfinished important negotiations that the shareholders are devoutly wishing may bring them some relief from the bitter experiences of the past.

From the outset, however, there have been more or less important negotiations pending which the Coalite shareholders have been allowed to look at by the phantasmagoric aid that has been at the command of those responsible for the existence of the Syndicate and Company. The shareholders have been surfeited with this sort of thing; and they will no doubt, in consequence, suspend their judgment as to the "importance" of the present negotiations until they are permitted to size them up on their own account. This apparently they will not be allowed to do before the expiration of another three months. Measured by the time already absorbed and to be absorbed by the negotiations and the presentation of the result, they must be important indeed. We hope that, after the mountain has been in labour all this time, something more than a mouse will be the product. Anyway, it would be a matter of deep regret if the visit that Sir W. H. Preece is making to the Cape should prevent his presence at the meeting at the end of March. But as he is starting on Jan. 14, there ought to be plenty of time for his return. How is it, by the way, that he can be spared from the country, out of contact with his colleagues, while such important negotiations are pending?

Gas in the Railway Disaster.

THE horror of the terrible railway catastrophe that took place at Hawes Junction on the Yorkshire Moors, at an early hour on the Saturday preceding Christmas day, must have struck home to every sympathetic being. In our pages reference to the accident has really little place, although gas conveyed in cylinders (which has no analogy to ordinary town gas supply, and the latter is not subject to similar mishap) has been indicted and condemned without a fair trial as having been at the bottom of the secondary terrible aspect in the great disaster. This indictment and condemnation have appeared in many representative papers of the lay press; and it is because of this, and because we know that it is a matter that has been fanned in the electrical interests, and is intended not only to injure gas lighting on railway trains, but gas lighting generally, that a comment on the matter will not be regarded as out of place in these columns. If it were merely the question of the relative dangers of the two illuminants under ordinary circumstances, it would be easy to dismiss the subject by allusion to the awful and fatal fires electrically generated at Clapham, at Accrington, and elsewhere. But we will deal with this railway case alone on the available testimony.

It has been assumed by the public press, or by those from whom inspiration has emanated—our competitors have a peculiar facility for assumption—that gas was the cause of the fire on the ill-fated train. There is not an atom of evidence to support the theory. Happily such occurrences as that with which we have to deal are comparatively rare on British railways; but, on American railway systems where electricity is almost universally employed for lighting, fires on wrecked railway trains have been much more common than in this country. The fires on the engines have been the generating cause, and the combustible material of which the trains were composed has supplied the fuel. Through this, steel-constructed carriages—although more expensive, and though electricity is employed as the illuminant—have become the vogue. Whether trains are electrically or gas lighted, while they are composed of such dry combustible material, in train disasters where the conditions of fire and wind are favourable, fires will not be averted.

Now let us examine the known conditions in connection with the Midland disaster from the evidence that is before us, as supplied by railway officials and others who were on the spot at the time of the accident. The train was not continuously gas lighted. There were two sleeping cars in the centre that were electrically lighted; so that there was not a continuity through the train of the gas lighting or of the gas cylinders. The electrically lighted sleeping cars were destroyed with the two front carriages of the train. But the two rear carriages were not; and these rear ones were gas lighted the same way as those in front of the sleeping cars. When the accident occurred, the gas-lights went out in the carriages, as well as the electric lights in the front sleeping car. The probability is that the gas cylinders in an accident of this kind (which smashed the front carriages up like match wood) would become ruptured or injured in some way, and, the gas being under pressure, would dissipate immediately, especially with a gale blowing as described by the witnesses. The engine-driver, W. J. Judd, states that he could not detect a smell of gas; and this, under such circumstances, is not surprising. It is quite clear, too, that, though the lights had been extinguished and the train was in darkness, an appreciable time elapsed before the fire broke out; so that the gas would have had ample time to escape and be dissipated. Thus whatever it was that caused ignition of the carriages must have been external to them.

The evidence all points to the cause being the fires of the second engine attached to the train. A shepherd, named Arthur Ashton, was the first in the neighbourhood to reach the scene of the disaster; and no doubt he was in a less excited state than those who had been involved in the accident. His version is (as recorded in the "Daily "Telegraph" yesterday week) that, when he reached the train, the "second engine was on fire." The description perhaps is not quite correct; but the meaning is plain. He also stated that it was probably half an hour from the time of the smash that the telescoped carriages which were attached to the burning engine caught fire. George Mills, too, one of the guards on the train, asserts that he heard no explosion, and had no idea how the fire started. "It might "have been from the engine fires, or from gas." He also declares, supporting Ashton, that the fire broke out in the front part of the train. Thomas Butlin, one of the sleeping-car attendants, states that the fire broke out about one-and-a-half yards from the front of the train—that is to say, close to the engine from which flames were being driven in the direction of the carriages. All the witnesses likewise speak of the strong gale that was blowing from the engine end along the train, fanning the flames, and adding to the intensity and the rapidity of the combustion. Here, then, we have all the conditions for what occurred after the wreck. Tongues of flame from one of the engines, a driving wind carrying the flames in the direction of the splintered carriages, and the carriages themselves composed of most combustible material. Under such circumstances, is it just, as the Daily Press has done, to arbitrarily and decisively ascribe the cause of the fire to the gas remaining in the cylinders at the time of the collision, though it is questionable whether the gas was there for many seconds?

Electrical Strategy in Gower Street.

The electricians responsible for the installation of the electric lamps in Gower Street forming part of what the Holborn Borough Council intended to be an honest comparative trial of gas and electric lamps of 300-candle power, measured according to the Westminster specification, have turned the whole thing into what appears to us to be practically a fiasco by what is no doubt considered by them as a very clever ruse. The Gaslight and Coke Company, in the northern part of the trial area, have put up seven lamps, which comply closely with the requirements of the Borough Council; but the Electric Light Company have erected not only *a larger number* of lamps in the portion allotted to them, but the lamps give more than 50 per cent. *in excess of the candle power specified* by the Council—in fact, readings of the lamps as first installed showed them to be nearly double the specified candle power. This exemplifies the lengths to which electrical people now consider it necessary to go, in order to attempt to save something from the sweeping successes of the inverted gas-lamps in districts where municipal ownership of the electricity supply does not dominate. Naturally, under the circumstances of the so-called comparative "trial," one has only to go into Gower Street to see at once the superiority in respect of the degree of illumination of the electric lighting. Surely, neither the Holborn Council nor anyone else will seriously take this as an honest experiment. It furnishes a lesson, however. It is that, in any future trials, the number of lamps to be put up in a certain length of street must be specified, and that the lamps selected must closely approximate the defined candle power per unit; otherwise one side or the other can reduce a trial to an utter absurdity. The dissimilar trial installations will be up for about a month; and then we suppose the tenders will be considered by the Council. In this matter, the

Gas Company are also placed at a disadvantage, in that the Electric Light Companies know the prices already quoted by them. But the matter has yet to be dealt with by the Council. By what has been done in Gower Street, we are reminded of the comparison recently made by the Chairman of the Lighting Committee of the Islington Borough Council, of the incomparables —electric arc lamps and low-pressure vertical gas-burners [see "JOURNAL" Dec. 20, p. 836]—to demonstrate the "superiority" of electric lighting. Were it not for the interests involved, we should be inclined to excuse these irrational proceedings on the ground that this is the pantomime season. However, there is another side to this public lighting question; and it is the wholesale success of the new inverted gas-burners in the public lighting contracts that have been going in London lately. The last extension of the list of successes was the securing by the Gaslight Company of a seven years' contract with the Borough of Chelsea for the relighting of the whole district by new inverted burner lamps of the Westminster type. The Paddington contract (which, on consideration of competing tenders, it is again recommended shall go to the Gas Company) will be before the Borough Council this evening.

Demonstration.

Do gas undertakings take every good opportunity of demonstrating the merits of their wares? We are afraid that all do not; and it can only be one of two things that deter—indolence or parsimony. This is a pity, because one cannot tell where the effect or impression of a demonstration at an appropriate time is going to end. Who can tell the end of the excellent impression that was made by the contribution of the Wandsworth and Putney Gas Company to the Christmas illuminations of High Street, Putney? The Company suspended centrally over the roadway six high-power lamps; and the "Borough News" states that the lamps "threw out a dazzlingly brilliant light." Needless to say, too, this venture on the part of the Gas Company has been appreciated by one Alderman who has been busy advocating in the Council Chamber the better lighting of the shopping centres. Our local contemporary advised all interested to visit the demonstration of lighting, and expressed the opinion that the adoption of the new lights would certainly be a great advantage to the High Street. The leaders in local affairs appear to have been agreeably surprised by the display. That is what is wanted—demonstration to surprise people. To cause surprise is to ensure the matter being talked about—in this way leaving an enduring impression.

Work and Pay.

For some considerable time past, the Nottingham City Council have been occupying themselves with the questions of one day's rest in seven for their employees and of the payment of a minimum wage. Twelve months ago, a resolution was passed expressing the opinion that the workmen should have one day's rest in seven, and directing the various Committees to make arrangements accordingly. But subsequently, on requests from severa Committees to be exempted from the order, a Special Committee was appointed to consider and report upon the best means of carrying out the resolution. The Special Committee have now formulated their conclusions; and they show that in various departments it is impossible to do without Sunday labour. In the electricity department, it has been practicable to establish a system of one day's rest in seven—with results that are perhaps not altogether appreciated by the employees, inasmuch as the effect is that 31 men lose among them the sum of £218 per annum, while the cost to the department is £31 a year. Some engineers and stokers are at work at the water pumping-stations on Sundays; and in view of the fact that the engines may be required to work continuously, it is, the Committee say, impossible to make any alteration in the existing arrangements. As to the gas department, it is pointed out that the great majority of employees have one day's rest in seven; Sunday labour affecting only the carbonizers and a few others, as everything has been done to minimize Sunday work as far as possible. There are three Sunday shifts worked in winter, and only two in summer; while the men engaged have been cut down to the lowest practicable number. The shutting-down of any works where gas is manufactured is impossible. The Committee remark that the opposition of the carbonizers themselves to the reduction of their shifts from seven to six per week stands in the way of the re-arrangement of Sunday work; and, this being so, they are of opinion that it is not now practicable to alter the present method in this department. Judging from the report, there does not seem to be anything to complain of in the existing state of affairs; and the men concerned are hardly likely to be keen on any fresh arrangement, in view of the Committee's statement that they are not able to recommend the Council to pay any of their workmen for time during which they do not work, in consequence of the passing of the original resolution by the Council with reference to one day's rest in seven. The Committee had also before them the question of a minimum wage; and, while recognizing that the different grades of labour and the varying efficiency of the employees make this proposal an extremely difficult one to carry into effect, they recommend that as a general rule a minimum wage of 5½d. per hour should be paid to the male able-bodied workmen in the employ of the Council who are over the age of 21 years. Certain exceptions are set forth; but nevertheless the estimated direct cost of carrying into effect the recommendation is about £1700.

Urban District Council Finances.

The figures appearing in Part VI. of the Annual Local Taxation Returns show that the financial transactions of the Urban District Councils—to the affairs of which bodies this particular Blue-Book refers—are on an important scale, though naturally the amounts involved are less imposing than those connected with the Borough Councils, whose accounts for the year 1907-8, to which the present batch of returns refer, were noticed in the last issue of the "JOURNAL." The statistics then given with regard to the larger local governing bodies are supplemented to-day by information relating to Urban District Councils. This is as far as possible on similar lines, but, as usual, without any mention of the sums, in connection with "reproductive" undertakings, which were either handed over in relief of rates or had to be allocated to make good deficiencies in revenue of trading concerns. At March, 1908, there were 327 boroughs (exclusive of the Metropolis), while the number of urban district councils was 813; but while the rateable value of the former was over £74,000,000, that of the latter was only £33,000,000. In the matter of the total amount of loans outstanding, the difference is even greater. In the case of the borough councils, the figure is nearly £247,000,000; whereas in that of the urban district councils it is only some £36,000,000. Many of the items comprised in these loans are, of course, the same in both instances. We are, however, now considering the urban district councils; and of the sum owing by them, 23·8 per cent. is for purposes of sewerage and sewage disposal, 15·1 per cent. for water-works, 9·7 per cent. for gas-works, 10·7 per cent. for education, 8·6 per cent. for street improvements, 6·5 per cent. for electric lighting, and 5·8 per cent. for tramways and light railways. Altogether the loans outstanding in respect of undertakings which yield revenue and for works of private improvement (and which amount is recoverable) represent, in the case of the urban district councils, 40 per cent. of the total debt. Of the receipts of these councils for the year 1907-8, the amount raised by means of public rates accounts for 54·4 per cent.; the receipts—not profits, of course—from revenue producing undertakings and private improvements representing rather less than 24·5 per cent. of the total income. It is pointed out in the report that in recent years there has been a distinct slackening in the rate of increase on the debt of urban district councils. In the four years to March, 1908, the increase was only £3,500,000, or 10·9 per cent.; and this compares very favourably with the preceding similar period, when, however, "education" was responsible for large borrowings. Of the £3,500,000 added to the outstanding loans during the last four years, electric lighting has been responsible for about £250,000; and tramways and light railways, for £720,000. The outstanding loans on gas-works have, however, in the same time only increased by some £10,000; and those on water-works, by £45,000. The average amount in the pound of the rates received by district councils (other than for purposes of elementary education) in the year under review was about 3s. 2½d. in the pound; but, in addition, elementary education was responsible for a rate of 1s. 3¾d. in the pound in the districts in which a rate for this purpose had to be levied.

The personal estate of the late Mr. James Stelfox, whose death was recorded in the "JOURNAL" last September, has been valued at £6969, of which £3368 is English estate.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 56.)

THE Stock Exchange wound up the year 1910 with a short week of four days; but it was a pleasant one. For however quiet markets might be, the tone was one of unabated cheerfulness—buoyed up by abounding confidence that the New Year is going to bring better things (and, notably, improvement in gilt-edged securities), which they certainly need. The Exchange reopened on Wednesday with a favourable tendency. Government issues were mostly in good demand; but Consols were ⅛ easier. Nice traffic figures were cheering to Rails; and the Foreign Market stood well. Thursday was a little more active and quite cheerful; but again Consols were a disagreeable exception. Movements elsewhere were almost uniformly for the better. The good tone was well maintained on Friday, despite a little profit-taking and some Portuguese rumours. Consols were firmer. Saturday, though very quiet, was a bright and cheerful closing day to the year, and almost all departments were strong. In the Money Market, there was a good demand for short loans, and high rates were commanded; but discount gave way. Business in the Gas Market was naturally not very brisk. The tendency was, however, quite favourable, and further advances in quotations were made. In Gaslight and Coke issues, the ordinary was stronger at from 105½ to 106¼—a rise of ½. In the secured issues, the preference was done at 103¼ and 104¼. South Metropolitan was unchanged at from 121½ to 122¼. In Commercials, one bargain was marked in the 3½ per cent. at 101½, and one in the debenture at 78 special. Among the Suburban and Provincial group, Alliance changed hands at 81⅜ and 81½, Brentford old at 253 and 254 (a rise of 2), ditto new at 193½, and Brighton original at 219. In the Continental Companies, Imperial marked from 185¼ to 186, and Union 86½ and 87. Among the undertakings of the remoter world, Monte Video was done at 12¼, Melbourne 5 per cent. at 100¼ and 101 (a rise of 1), Primitiva at 7 7/16, and ditto preference at 5 5/16.

According to usual custom, we append a table showing the closing prices at the end of 1909 and the end of 1910, with the respective gains and losses in value. Variations have for the most part been slight, except in cases where special factors have operated. A feature of general application is the shrinkage in value of debenture stocks, which have suffered during the year in common with other high-priced securities of their class.

GAS COMPANIES.	Prices on Dec. 31, 1909.	Prices on Dec. 31, 1910.	Gain or Loss.
Alliance and Dublin, Ordinary	.. ..	80—83 ..	..
Do. 4 per cent. Deb.	100— 02 ..	96—98 ..	−4
Bombay, Limited	5⅛—6 ..	6⅜—6⅞ ..	+¾
Do. New, £4 paid	4⅛—4⅜ ..	5—5¼ ..	+⅜
Bournemouth, 10 per cent.	28½—29 ..	28½—29½ ..	+½
Do. B 7 per cent.	16¼—16⅜ ..	16¼—16⅜ ..	..
Do. Preference 6 per cent.	15¼—15⅜ ..	14¾—15¼ ..	−⅛
Brentford, Consolidated	253—256 ..	252—255 ..	−1
Do. New	189—192 ..	193—196 ..	+4½
Do. 5 per cent. Preference	120—124 ..	120—122 ..	..
Do. 4 per cent. Debenture Stock	99—101 ..	97—99 ..	−2
Brighton and Hove, Original	217—220 ..	217—220 ..	..
Do. A Ordinary Stock	153—156 ..	158—161 ..	+5
British	42⅜—43⅜ ..	44—45 ..	+1⅝
Bromley, A 5 per cent.	118—120 ..	119—121 ..	+1
Do. B 3½ per cent.	88—90 ..	89—91 ..	+1
Do. C 5 per cent.	106—108 ..	109—111 ..	+3
Do. 3½ per cent. Debenture	87- 89 ..	83—85 ..	−4
Buenos Ayres, 4 per cent. Debenture	98—100 ..	95—97 ..	−3
Cape Town and District, Limited	3—4 ..	3—4 ..	..
Do. 4½ per cent. Preference	5¼—5⅞ ..	4⅝—5⅜ ..	−½
Do. 6 per cent. 1st Mort.	48—49 ..	.. ..	..
Do. 4½ per cent. Deb. Stock	80—82 ..	88—90 ..	+8
Chester 5 per cent. Ordinary	108½—110½ ..	109½—111½ ..	+1
Commercial, 4 per cent. Stock	109—111 ..	106—109 ..	−2½
Do. 3½ per cent. do.	104—105 ..	101—103 ..	−2
Do. 3 per cent. Debenture Stock	80—82 ..	77—79 ..	−3
Continental Union, Limited	95—97 ..	86—91 ..	−7½
Do. 7 per cent. Preference	137—139 ..	134—136 ..	−3
Derby, Consolidated Stock	121—123 ..	122—124 ..	+1
Do. Debenture Stock	103—105 ..	104—105 ..	+½
East Hull, 5 per cent. Ordinary	97—99 ..	103—105 ..	+6
European, Limited	24⅝—25 ..	23⅞—24½ ..	−⅝
Do. £7 10s. paid	18½—19 ..	17⅞—18⅝ ..	−¾
Gaslight and Coke, 4 per cent. Ordinary	103—104 ..	105⅝—106½ ..	+2½
Do. 3½ per cent. maximum	87—89 ..	86—88 ..	−1
Do. 4 per cent. Con. Pref.	103—105 ..	103—105 ..	..
Do. 3 per cent. Con. Deb.	81—83 ..	78—80 ..	−3
Hastings and St. Leonards, 3½ per cent.	92—94 ..	93—95 ..	+1
Do. 5 per cent.	117—119 ..	.. ..	..
Hongkong and China, Limited	17⅛—18 ..	17—17⅛ ..	−⅛
Ilford, A and C	144—146 ..	146—149 ..	+2½
Do. B	108 110 ..	115—117 ..	+7
Do. 4 per cent. Debenture	100—102 ..	96—98 ..	−4
Imperial Continental	175—177 ..	185—187 ..	+10
Do. 3½ per cent. Deb. Red.	94—96 ..	94—96 ..	..
Lea Bridge Ordinary, 5 per cent.	119—121 ..	121—123 ..	+2
Liverpool United A	223—225 ..	220—222 ..	−3
Do. B	166—168 ..	164—165 ..	−2½
Do. Deb. Stock	102—104 ..	102—104 ..	..
Malta and Mediterranean	4⅜—5 ..	4⅜—4⅝ ..	−⅛
Metropolitan of Melbourne, 5 p.c. Deb.	99—102 ..	100—102 ..	+⅓
Do. Do. 4½ p.c. Deb.	100—102 ..	99—101 ..	−1
Monte Video, Limited	12¼—13 ..	12¼—12⅜ ..	−⅛
Newcastle and Gateshead, Consolidated	106—108 ..	101⅝—102½ ..	−5
Do. 3½ p.c. Deb. Stk.	91—93 ..	90—91 ..	−1½
North Middlesex, 7 per cent.	13—13½ ..	13⅝—14⅛ ..	+⅝
Oriental, Limited	137—139 ..	137—139 ..	..
Ottoman, Limited	6⅛—6⅜ ..	6¼—6½ ..	+⅛
Portsea Island A.	137—139 ..	132—134 ..	−5
Do. B.	129—131 ..	125—127 ..	−4
Do. C	122—124 ..	118—120 ..	−4
Do. D and E	101—103 ..	103—105 ..	+2
Primitiva, Ordinary.	7⅛—7⅜ ..	7⅛—7⅜ ..	+1/16
Do. 5 per cent. Preference.	5⅛—5⅜ ..	5⅛—5⅜ ..	..
Do. 4 per cent. Deb. Stock	97—99 ..	95—97 ..	−2
River Plate, 4 per cent. Deb.	98—100 ..	95—97 ..	−3
San Paulo, Limited	14⅛—15 ..	15⅜—15⅝ ..	+⅜
Do. 6 per cent. Preference.	11⅞—12⅛ ..	11⅛—11⅜ ..	−½
Do. 5 per cent. Deb. Stock.	51—52 ..	51—52 ..	..
Sheffield, A.	233—235 ..	229—231 ..	−4
Do. B.	233—235 ..	229—231 ..	−4
Do. C.	233—235 ..	229—231 ..	−4
South African	12⅛—12⅜ ..	10⅞—11⅛ ..	−1⅛
South Metropolitan, 4 per cent. Ordinary.	120—122 ..	121—123 ..	+1
Do. 3 per cent. Deb. Stk..	82—84 ..	80—82 ..	−2
South Shields Consolidated Stock	160—162 ..	155—157 ..	−5
South Suburban, Ordinary 5 per cent. Stk.	120—122 ..	120—122 ..	..
Do. 5 per cent. Preference Stk.	120—122 ..	120—122 ..	..
Do. 5 per cent. Debenture Stk.	122—124 ..	122—124 ..	..
Southampton, Ordinary	109—111 ..	113—112 ..	+1
Tottenham and Edmonton, A 5 per cent.	133—135 ..	141—143 ..	+8
Do. B 3½ per cent.	111—113 ..	113—115 ..	+2
Do. 4 p.c. Deb. Stk.	98—100 ..	95—97 ..	−3
Tuscan, Limited	9—9⅛ ..	8⅞—9⅛ ..	−⅛
Do. 5 per cent. Deb. Red.	100—102 ..	98—100 ..	−2
Tynemouth, 5 per cent. maximum	110—112 ..	114—115 ..	+3½
Wandsworth and Putney, B 3½ per cent.	139—141 ..	142—144 ..	+3
Do. 3 p.c. Deb. Stk.	72—74 ..	73—75 ..	+1

ELECTRICITY SUPPLY MEMORANDA.

A Review of the Past Year.

THE year that has just closed has been for the electrical industry one of much unrest, due entirely to affairs having persistently deviated from the path to which the industry would have preferred them to be confined. Still, it has been a year in which the knowledge of the men of the industry has expanded in a remarkable degree. They have learnt much more of their gas competitors and their resources than they were cognizant of before; and they have learnt a good deal as to what the public think of the shortcomings of many of their own appliances. But our electrical contemporaries have found relief in occasionally conjuring up the most ghastly things about the gas industry. Our old, sedate, and highly respectable friend the "Electrical Review" has actually fallen into such a morbid state that, during the year, it has liked to think of the gas industry writhing in agony in "the last ditch;" the "Electrician" has predicted the early death of the gas industry, through the wholesale transfer of artificial lighting from gas to electricity, and the absorption by the electrical industry of the heating and cooking business now possessed by the gas industry; and as to our highly esteemed friend "Meteor" and the Editor of the "Electrical Times," they are both past all——stay, the flighty "Meteor" has asked us to give him a little innocent pleasure by saying a good word for him occasionally. There is such a thing as conscience; so perhaps he will obtain the glow of satisfaction that he so much desires if we refrain on this occasion from the use of a harsh word. This is a good start for the New Year; but how long it will continue is a matter over which perhaps it is well not to make any promise.

However, as we were saying, the year has been one of considerable unrest for the electrical industry. Things have not gone well with it. The year started under the shadow of a life and property sacrificing fire at Clapham caused by an electric lamp; it was succeeded by the fatal fire at Accrington; it ends with one at Maidstone, for the origin of which the finger points unmistakably to electricity. Many others have occurred in connection with the origin of which electricity is under strong suspicion. Quite a number of failures of supply have happened in the course of the year which have helped to spread distrust in electricity supply. Notwithstanding all the printed bombast as to heating, cooking, and water heating by electrical means having attained a high state of perfection, and being cheaper than, or as cheap as, the use of gas for those purposes, electricity suppliers have found that the public are not prepared to endorse the statements born of the enthusiasm (inspired by electric appliance manufacturers) of electrical journalists. In regard to lighting, users of electricity for lighting purposes who have to work or read for hours under the glare of metallic filament lamps are beginning to talk of the effect on their eyesight; and, wisely, some electricians are advising consumers to spend money on prismatic or frosted globes, or to run the lamps out of range of the sight—near the ceilings. It is being found more and more now that the lines of the commercial development of the electricity industry have brought it to the position when high-priced units are receding in their number, and are being swamped by low-priced ones. Thus the average revenue per unit is running down at a rate out of all proportion to the reduction made in works costs, capital and establishment charges, and so on. There has been a great amount of scheming during the year to meet this condition, by devising new tariff schemes. The Leicester decision, too, came as a bad blow for municipal traders in electricity, which decision denied the right of electricity suppliers, without express parliamentary sanction, to enter into the wiring and fitting business. There was also the West Ham case, in which the Courts pronounced the illegality of overdrafts and borrowings beyond the limits of sanction, to which so many electricity concerns have of late been prone.

A certain section of the Electrical Press has, late in the day, also come to the conclusion that the electrical industry has not the right sort of commercial men at its head; and when there has been a little tiring of kicking the electrical engineer, the manufacturers of electrical appliances have served as a change. The manufacturers complain of the persistence of the cloud that has hung over them. At Local Government Board inquiries, there

have been some curious revelations as to how the electricity business is conducted—conducted in a manner that no business man would think of applying to his own business. But above all the electricity supply industry has had shock after shock from the inverted gas-lamp gaining contracts for public lighting for terms of years, in some cases with electric lamps in competition. There had been no idea on the part of our electrical friends that gas lighting had advanced so far as it has done in efficiency and economy. It was not thought by them that a high-pressure gas-lamp could be made that would give 3000 to 4000 candle power. The melting-down of the whole lantern, with the molten metal and glass trickling down the gas standards, was pictured. The knowing ones of the electricity industry did not believe inverted incandescent gas-lamps could be centrally suspended, and high-pressure gas be supplied to them. The "Electrician" painted an awful picture of how the streets of the West-end would look when ghastly incandescent mantles were trying to illuminate them. Disbelief and the misgivings of over-wrought electrical brains have caused much amusement in the gas industry, just as has done the muteness of the sceptics and critics on demonstration. It has, indeed, been a year of great unrest for the electricity industry; and one in which educational and error-correcting work by the gas industry made of many electricians wiser, if sadder, men.

It may be profitable to go with a little more detail into some of these matters. The very fact that the electricity supply industry has found it necessary to form an Electricity Publicity Committee, and to spend so much money as is now being done on an advertising campaign, is one of the material signs that the industry is not sweeping all before it, and needs immense strengthening. It dec ares, as plainly as anything can do, the difficulties that are in the road of the electricity industry in expanding the business field already occupied. It is true the gas industry has now its Gas Publicity Committee, who are engaged in developing their plans at the present time; but this Committee must be looked upon as the answer of the gas industry to the Electricity Publicity Committee, with a large part of its duty directed to the correcting of the misrepresentation and malicious defamation circulated by the latter and by electric lamp manufacturers. There will be plenty for the Gas Publicity Committee to do; for in electrical advertisements we have seen some of the grossest untruths and insinuations as to poisonous products, and gas burner and gas fire efficiencies, as well as the suppression of material facts. To this kind of thing the electricity supply industry has descended, and is financing, for the purpose of expanding its business. Such methods are not honourable. We have asked the Electricity Supply Committee and advertising electrical traders to supply proof of certain statements. But we might just as well appeal to a brick wall.

The metallic filament lamp has played an important part in the affairs of the electrical industry during the year. It has not had the expected effect in extending business; but it has had considerable effect on the revenue of electricity undertakings, by supplanting carbon filament lamps—the result being that while the volume of high-priced units has been shrinking, the volume of the low-priced ones for power and other purposes has been expanding. The effect has been a drooping of the average price obtained, without a countervailing reduction of the works, capital, and other charges. This being so, there has been an extensive display of vigour on the part of electricity undertakings in trying to develop schemes for producing compensation. But not much success has had to be chronicled. There has been feverish anxiety over the matter; and some electrical engineers have shown more fright than discretion in regard to the situation. Any and every proposal that has come along has been jumped at as offering a possible solution of the difficulty. The Norwich or "telephone" system of charging—that is, a fixed charge per annum or quarter, and a low price per unit—has been welcomed with open arms as a means of succouring depreciating revenues. Wild-goose schemes have been introduced, of fixed prices per lamp, and of supplying workmen's dwellings without meters with lighting by lamps of insignificant power at a price per week to be collected by benevolently inclined landlords with the weekly rent. Free wiring has again been dragged forth; and despite the losses of municipal speculators in this business, many others, in their distress at seeing revenue on the down-grade, are inclined to indulge in the risk. But, where adopted, all or any of these schemes have only had a transitory, or, perhaps more correctly expressed, a sort of flash-in-the-pan effect. Some companies and municipalities have taken the bull by the horns and increased their prices. Called to mind are the Metropolitan Electric Supply Company, Limited, the Brompton and Kensington Company, and the Dublin, Wakefield, and Newport (Mon.) Corporations. They have been reviled for believing that they know their own business better than other people; and bricks labelled "retrogade," and other expressive words, have been freely hurled at them by people who have not the responsibility of the management of the undertakings. There are central station men who say it would be better in the long run to lower the prices than to raise them. They do not see that the argument does not support the electrically laureated advantages of electricity, nor the "cheaper than gas" legend. For this we must wait until the consummation of Ferranti's dream (told from the Presidential chair of the Institution of Electrical Engineers), when electricity will be distributed throughout the country at an average price of $\frac{1}{8}$d. per unit.

Among farcical business-inducing statements of the electrical industry is the one that the metallic filament lamp produces a saving in electricity bills of 75 per cent. The Smithfields Market Electric Supply Company had a bad financial report to present to the shareholders on the last occasion of their meeting, as, owing to the change-over from carbon filament to metallic filament lamps, the revenue per lamp fell from 7s. 8d. in 1908 to 5s. 9d. in 1909. To be in accord with advertised performance, the revenue should have fallen to about 1s. 11d. per lamp. A great deal has been learned in the twelvemonth as to the life of metallic filament lamps, as to their cost to the consumers, and as to their fragility when cold, which is their condition during the greater part of their existence. Electricians speak loftily of lamps lasting 3000 and even 4000 hours. Some figures published in the "JOURNAL" for Oct. 11 (p. 95), showed, from experience at Swindon, how erratic is the life of the lamps. At a recent meeting of the Illuminating Engineering Society, too, we heard of trouble from the blackening of the bulbs; and on the before-mentioned subject of the glare, and of the ill-effects on the sight, of lamps with filaments of such great intrinsic brilliancy, much was heard during the year at the meeting of the Society—Mr. W. M. Mordey, Mr. A. P. Trotter, Dr. Marchant, and other men of repute in the electrical world bearing quite frank testimony to the trouble and danger. The "Electrician," too (an authority of no mean repute on all matters from the insignificant business of running a multi-million capitalized gas undertaking to the physiological question of the evil effects of electric lamps on the eyesight), says that "greater care will be taken—in fact, will have to be taken, if we are not to suffer optically by the abuse of the light." Holophane globes and concealed lighting are the recommended remedies; and, consequently, on to the cost of lighting electrically, this remedial expenditure has to be tacked.

The metallic filament lamp has been responsible, too, for street lighting coming much to the fore of late. With electricity at an extraordinarily low rate—a rate that has no comparison whatever with the price at which large private consumers are supplied for lighting purposes—it is said that, in certain areas in which the electricity supply is in the hands of the municipal authority, electricity for street lighting can compete with gas, both in cost and efficiency; but, singularly, this has not been found to be the case during the year in areas where electricity supply is in the possession of companies. This reveals one of the mysterious influences of municipal possession. Further confirmation of the cheapness of electricity for street lighting purposes has been furnished by taking Marylebone, Hampstead, and Shoreditch (all municipally supplied), and comparing the new style electric lighting with the old style vertical incandescent gas-burners—ignoring altogether the existence of the newer inverted gas-burner. Still further confirmation has been discovered at Islington by comparing flame arc lighting with ordinary-pressure low-power gas units of the old type. The dishonesty of the comparisons is their most distinguishing feature. But apart from being blind to modern gas progress in making comparison, the ratepayers, wherever electricity is employed, find the financial burden of the public lighting service an increasing one, whether taken in the whole or per mile. But during the year in London the inverted gas-burner has secured excellent contracts for a number of years in several borough council areas [see "JOURNAL," Dec. 27, p. 904], and now we have Committees of the Paddington Borough Council, after considering an electric lighting tender, adhering to a former recommendation as to up-to-date gas lighting being adopted. The settlement of the Holborn contract remains in suspension during the run of the trial installation in Gower Street. Also in the Provinces, gas has been winning in favour in competition with electricity where gas has not to face the despotism that has been implanted by municipal ownership of the electricity undertaking. But the greatest sensation experienced by the electricity industry during the year was the gaining by the Gaslight and Coke Company of the part of the Westminster lighting that was open to contract—involving many thousands of lamps and some of the central West-end thoroughfares in which electric arc lamps formerly reigned; while the greatest surprise experienced has been the effect of what has been done in the West-end with inverted gas-lamps—both high and low pressure, and of a variety of candle powers. "Who would have thought it?" was the remark that privately passed from lip to ear in the electricity industry. It had not been thought possible; hence the surprise. The same with the central suspension demonstration in the City. The same with the Brighton station lighting, where electric arcs were displaced. The confidence of the gas industry in its means of performing its duty in the public service was attested by the Gaslight and Coke Company entering into the Westminster contract on an illumination basis, with heavy penalties for default. But the electricity "industry"—as represented by "Meteor" and two or three others—does not like the terms of the illumination test applied in Westminster, and would prefer something that would give a preference to metallic filament lamps. Summing up, it may be taken that both in street lighting and in the lighting of public establishments, modern gas-lamps have held the field during the year against electricity where municipal ownership has not been thrown into the balance.

Reverting to private lighting it has been shown over and over again during the year that gas lighting is cheaper than electric lighting. At Chichester and Canterbury, some interesting public demonstrations were made by the Gas Companies with meters and lamps, showing the current consumed by metallic filament lamps and the gas burned by new forms of gas-lamps. There was a controversy in "The Times" in the course of the year on the subject, in which Mr. Hanbury Thomas took a prominent part.

Mr. A. H. Seabrook, of Marylebone, has stated that he was only able to retain certain of his consumers on account of cost by applying Holophane globes, and so, by directing the light where it is required, reducing the number of lamps needed. Where there have been challenges issued by gas people to disprove the declaration in the market place that "electricity is cheaper than gas," there have been no responses. The challenged electricians are good at silence when in a tight corner. But the cry as to cheapness has not been quite so loud during the year, as people are finding out that the cry and actuality have nothing in common. People are also beginning to ask why, if electric lighting is cheaper than gas lighting, it is necessary to reduce the price of current per unit to almost vanishing point in order to compete with gas for street lighting. The defamation of gas in respect of the pollution of the air has not "caught on" among consumers, although electrical engineers continue their farrago of nonsense from a base of pure fabrication. We still fail to get explanations from the electrical defamers as to what they mean; they also refuse to say whether the conditions that are said to exist in some factories are those that prevail in ordinary gas-lighted houses. Meantime, the Electricity Publicity Committee, when advocating in one of their leaflets the use of electric lighting, declare that electric fans are "indispensable for keeping the house healthy." The Society of Medical Officers of Health have assisted in laying low the slanderous assertions of electrical people by adopting in their meeting-room gas lighting and hot-water circulation for heating (using gas-heated boilers), together with a gas fire. In this room electric ventilating fans are employed; but, in the two exhibition rooms, inverted gas-burners are used, without any special provision for ventilation.

Heating, cooking, and water heating have not been successful branches of the electrical business during the year. Some blame the apathy of electrical engineers; some the makers of the electrical appliances. But the foremost reason is that electricity has a low thermal value; a second one is that electrical appliances of the kind are fairly expensive to construct; a third one is their unreliability; a fourth—perhaps it will be kind to break off here. The virtues of the numerous appliances have been writ-large on paper. There they have remained, as there is a strong tendency among the British public to deal with realities, rather than with hypotheses.

There is much else that might be said about the disappointments and fugitive hopes of the year—about the negative results of municipal trading in many places, about the disclosures at Local Government Board inquiries, and about the slow progress of the power business, except in specially favoured places. The London Fire Brigade Committee's annual report again showed how greatly in excess in proportion to the number of consumers are electrically generated conflagrations to those originated by gas. The Chief Officer of the Fire Brigade has also issued warning and instruction with the view to preventing trouble from electricity during the Coronation illuminations. After the terrible Clapham fire, the Phœnix Insurance Company thought fit to revise their electricity rules. It is not surprising. The fire cost the Insurance Companies £130,000, of which the Phœnix Company had to find £33,000. This and other fires during the year had a very bad effect on the assistants of large shopping establishments who "live in." They do not like the mystery that surrounds these fires. Following Clapham was the great fire at Messrs. D. D. Evans and Co., of Kilburn, which caused £100,000 damage. Everything pointed to the electric light having been the cause. The Electrical Engineer of Hampstead (without personal knowledge of the matter) said—we repeat "said"—he was prepared to prove the fire was not caused electrically. The proof has not been forthcoming. From the list of fires, special mention may be made of the one at Accrington at the end of July, in which five lives were lost; and the one just lately at Maidstone, in which a boy perished, and for which electricity is under strong suspicion. Among other fires attributed to electricity, but consistently repudiated by our electrical contemporaries who were not on the spot at the time, were at the house of Mr. R. C. Swann, at Darlington; at the London Hospital on Feb. 4; at Hertford House on Feb. 9; at Birmingham, in the week ending March 12—at the works of the British Insulated Cable Company, and at Messrs. Bates' millinery establishment. At the beginning of June there were fires at Maidstone; at Herne Bay Pier on Aug. 4; one at least of the several fires in Brixton electrically lighted shops was traced to electricity; and at the inquiry into the deaths of assistants at one of the shops the local Electricity Company were represented. The fire at the Brussels Exhibition, the first reports placed to the account of electricity; the destruction of the Wellingborough Music Hall, towards the end of the year, was also so assigned; as was also a fire at the Star Hotel, Newport, Isle of Wight, on Aug. 23. The destructive fire that took place on Dec. 23 at the works of Messrs. Camper and Nicholson, of Gosport, was stated to be due to the fusing of an electric wire in a petrol store. At the Brighton Pavilion, the electric wiring has had to be renewed on account of what the Electrical Engineer described as its "dangerous condition." The Chief Electrical Inspector of Factories had the same tale to tell during the year as to the dangerous character of electricity, and several cases of fatality were included in his report. He also found it necessary to expound at length the numerous regulations designed to prevent accidents from electricity in factories and workshops.

From the foregoing, it will have been seen that the electrical industry has had to face a fair amount of failure during the year. There are failures of another kind to be recorded. Failures in the supply; and, as was philosophically remarked by one of our electrical contemporaries the other day, continuity of supply is essential to the commercial success of electricity. It is also essential to public safety. But with all that is done, private houses, shops, streets, railway stations, places of worship and of entertainment, are thrown into darkness without warning. The guileless character of electricity as portrayed in electrical literature is found in practice to be purely hypothetical. The failures noted by us during the year included one at Dublin, on Dec. 28, 1909; various at Dundee early in the year; at Leith on Jan. 7; at East Ham on Jan. 10; about the same time, there was a partial extinction in Paris; early in February, a collapse was suffered at Newport (Mon.); Bristol had the experience on Feb. 18; a Saturday night failure occurred about the end of June at Pontypool; on June 18, Wrexham was troubled; Woking on July 2; Brighton on July 9; Bridlington on Aug. 5; Southend on Aug. 13; Scarborough on Aug. 30; the Central Station, Liverpool, on Sept. 14; Southport on Feb. 25; Paris again in October on account of the railway strike; Glasgow on Dec. 6; and Middlesbrough on Dec. 10. The Editor of the "Worthing Gazette" complained bitterly during the year about the collapse of his electric motor through the cessation of energy at inconvenient seasons. He found the eccentricities of electricity more than flesh and blood, printing-machines, and publishing days, could stand. In the "JOURNAL" for Sept. 13, information was given from the report of Mr. Michael Longridge, of the British Engine, Boiler, and Electrical Insurance Company, as to failures of electrical machinery. Among other delinquencies of electricity reported upon during the year was the Long Acre fusion of a cable, by which the lives of several families were jeopardized by poisonous fumes. Noticed, too, were fusions of gas-mains by electricity both in Calcutta and Belfast. One of the last things recorded during the year was the awarding of damages to the amount of £525 to a Mrs. Elliott, against the Battersea Borough Council, for injuries occasioned by an occurrence incidental to electricity.

It has been shown in this review that there are very many things "incidental to electricity" besides burns and shocks. The electricity supply industry is hoping for a better time this year. We may as well be candid. It will not be the fault of the gas industry if its chief competitor obtains what it is hoping for.

Personal.

Mr. C. E. HOLT, an assistant in the Heywood Corporation Gas Department, has been appointed Superintendent of the Distribution Department of the Nuneaton Gas Company.

The Secretary of the Redhill Gas Company, Mr. HORACE LONG, who has just completed his twenty-one years' connection with the Company, was recently the recipient of a gold watch, suitably inscribed, presented by members of the staff to mark the occasion.

Obituary.

Mr. CHARLES HENRY ASHWORTH, who for thirty-six years had been employed in the Gas Department of the Corporation of Manchester, died suddenly, on the 23rd ult., at his residence in the city.

The death is announced of Mr. ALBERT HOWARD WALL, of the firm of Biggs, Wall, and Co. He was killed almost instantaneously while motoring in his tri-car on Christmas Day to see his parents at Barnet. The car skidded on the tram-line, throwing Mr. Wall on to his head and breaking his neck. The interment took place at the Islington Cemetery, Finchley, on Saturday.

The London and Southern District Junior Gas Association, and the members personally, have sustained a sad loss by the death of Mr. H. ROTHWELL, which took place at 2.30 on Sunday morning in the Westminster Hospital, where he had been lying for some time as the result of an accident by which he broke his thigh. Mr. Rothwell (who was in the employ of the Gaslight and Coke Company) was a member of the Council of the London Junior Association, in the proceedings of which he had always taken an active part; and at the last meeting the members passed a vote of sympathy with him and his family in their trouble. We understand that it was intended to hold an inquest.

Junior Gas Association in Toronto.—We learn from the "Gas Journal of Canada" that a Junior Gas Association has been formed in Toronto; and that, according to the syllabus issued for the first session, the opening meeting was fixed for the 1st ult., when the President (Mr. J. J. Armstrong) was to address the members. The session is to extend till the 28th of April, when the annual meeting will be held, followed by "high tea" and a smoking concert. The syllabus includes six papers on subjects useful to juniors, and a number of interesting visits to works. The Hon. President is Mr. Arthur Hewitt; and, as already mentioned, the President is Mr. J. J. Armstrong. The Vice-President is Mr. E. T. Rae; and the Secretary and Treasurer, Mr. Harry D. Keillor. Our Canadian contemporary congratulates the young men engaged in the gas industry in the Dominion on the initial success of their organization; and we cordially join in this expression, and trust the new Association may have a full measure of success.

GAS BILLS FOR 1911.

[First Article.]

As was pointed out when the notices appeared giving a forecast of the gas legislation for the first session of the new Parliament, the quantity, by way of Bills, is not large. Still such as it is, it cannot be deemed uninteresting. This will be seen as we proceed with the review of the measures as lodged. As customary, we shall deal in this first article with the gas companies who are seeking incorporation or re-incorporation.

The first Bill, in alphabetical sequence, is that of the Ashborne Gas Company, Limited, who are the successors of a company formed in 1840. They now desire to be incorporated, and to have full parliamentary powers conferred upon them. The present share capital of the limited company is £20,000, divided into 2000 shares of £10 each. The Company are at present supplying gas in Ashborne and the parish of Clifton and Compton, in Derbyshire; and the area of supply it is now proposed to extend to the parishes of Mappleton, Offcote, and Underwood and Sturston, in the county of Derby, and Mayfield and Okeover, in the county of Stafford. In view of the increasing business and the new territory, it is desired to extend the works and canalization, and for these purposes additional capital is necessary. The clauses of the Bill referring to incorporation are of ordinary character. It is proposed that the capital shall be £35,000, of which £20,000 will represent the original capital, and £15,000 the additional capital. In raising the latter (which will be subject to the new auction or tender clauses), the Company are to be limited to the issuing of an amount of preference shares or stock not greater than £7500. Respecting borrowing powers, the Company ask for one-third part of the amount of capital which, at the time of borrowing, has been raised under the powers now sought. The standard rates of dividend are to be on the original capital 10 per cent., and on the ordinary additional capital 7 per cent. On the preference capital the rate is not to exceed 5 per cent. Special purposes and reserve funds are arranged for; and in connection with the latter, the divisible profit carried forward is not to exceed the amount required to pay a year's dividend at the authorized rates. The contemplated standard price in Ashborne is 3s. 9d. per 1000 cubic feet, and beyond 4s. 3d. The sliding scale works on the ordinary terms. The prepayment clause is of the usual form. The Company propose placing themselves under a discounts clause, providing for discounts not exceeding 12½ per cent. for prompt payment and 15 per cent. for large consumption; but in an earlier part of the Bill, the extension of section 13 of the Gas-Works Clauses Act, 1847, is made: "Provided also that every such contract Cntered into by the Company shall be alike in terms and amount, under like circumstances, to all consumers." The standard quality of gas is placed at 14 candles, tested by the "Metropolitan" No. 2 burner. The Company desire power to apply for a Provisional Order to authorize the supply of electrical energy. [*Parliamentary Agents: Messrs. Hargreaves and Crowthers.*]

The Chapel-en-le-Frith, Chinley, and District Gas Company, Limited, seek re-incorporation, and enlarged powers. Their capital is £20,000, divided into 20,000 shares of £1 each; and their present area of supply is constituted of Chapel-en-le-Frith and Chinley, in the county of Derby. They are now asking for an extension of area to neighbouring parishes and to part of the parish of Fairfield within the limits of supply of the Buxton District Council, but which ground has not been supplied by the latter. Within the area mentioned, the Company desire the repeal of the powers of the Council. The proposed capital is £40,000, of which a moiety is the original capital, and the other the additional capital. In issuing the capital not more than £10,000 is to be raised by way of preference shares or stock. The Company are asking for power to offer new issues of additional capital to consumers and to persons in their employ, before submitting the capital for sale by auction or tender (under the new auction clause), "at as near as may be the average market price of the shares of the limited Company, or the shares or stock in the original capital of the Company, as the case may be in the six months preceding such offer, or at par, provided that in no case shall the price at which such shares or stock shall be offered be lower than 5 per cent. below such market price." The usual one-third borrowing power is desired. The standard dividend on both the original and additional ordinary capital is placed at 6 per cent., and 5 per cent. on the preference capital. Provision is made for special purposes and reserve funds. Additional land is scheduled for manufacturing and storage purposes. The standard price of gas is placed at 4s. per 1000 cubic feet; penny variations of price carrying changes in dividend at the rate of 3s. per cent. The prepayment clause is of the usual form. The standard illuminating power of the gas is proposed at 14 candles, tested by the "Metropolitan" No. 2 burner. Authority is requested to the application for a Provisional Order for the supply of electricity. [*Parliamentary Agents: Messrs. Crowders, Vizard, Oldham, and Co.*]

The Chasetown Gas Company, Limited, came into existence in 1870, with a nominal capital of £3000 in £1 shares, of which 2550 have been issued. The district supplied by the Company is within the statutory area of the Lichfield Gas Company under the Lichfield Gas Act, 1878. The Chasetown Gas Company, however, were supplying gas immediately after their formation in 1870; and they therefore ask for the amendment of the Lichfield Act by repealing the power in the district in question. The proposed area of supply is defined. The capital specified is £20,000 in 4000 £5 shares, of which one-fourth is to be preference shares entitled to a dividend of 5 per cent. For the holders of the present shares, 510 ordinary shares will be required; and the balance will form the new capital, which will rank equally with the shares issued to the existing holders. Borrowing powers are on the ordinary lines of one-third of the issued capital. It is proposed that the standard dividend on the ordinary shares shall be 10 per cent.; and, of the excess profits, the carry-forward is not to exceed an amount sufficient to pay one year's dividend at the authorized rate. The price of gas is not to exceed 5s. 6d. per 1000 cubic feet. This is subject to revision by the Board of Trade at the end of three years, or alternatively the Board may prescribe a standard price with sliding-scale on the lines of penny changes in price carrying alterations of dividend on the ordinary capital of 5s. per cent. The special purposes fund clause, the auction and tender clause, and the prepayment clause are all of them in the customary terms. The standard illuminating power is placed at 14 candles, tested by the "Metropolitan" No. 2 burner. [*Parliamentary Agents: Messrs. W. & W. M. Bell.*]

The town of Chesham in Buckinghamshire is supplied at present by a limited Company, with a capital consisting of £2900, divided into 290 ordinary shares of £10 each, £6905 divided into 1381 ordinary shares of £5 each, £195 divided into 156 ordinary shares of £1 5s. each, and £2000 divided into 400 preference shares of £5 each. The debenture issue amounts to £3150. The Company seek incorporation, and statutory powers; and they also ask that the undertaking of the Wendover Gas Syndicate, Limited, who are now supplying in the northern part of the parish of Wendover, should be vested in the Company. Regarding the clauses of the Bill, the limits of supply receive lengthy definition. The proposed capital is £52,000; and it is intended that it shall be upon the uniform basis of a 5 per cent. stock. Therefore the capital scheme provides that of the £52,000, £20,000 of the stock ("A") shall be created in respect of the existing ordinary capital of £10,000, £2000 in respect of the existing preference stock ("B"), and £30,000 will be the additional capital. The £20,000 ordinary stock, it is proposed, shall be distributed at the rate of £20 for each £10 share at present held, and in proportion in respect of the £5 and £1 5s. shares. The new auction clauses are to apply to the issue of the additional capital. Inclusive of the £3150 already raised, borrowing powers are desired to the extent of one-third part of the issued capital. Special purposes and reserve funds are arranged for. The clause referring to the purchase of the undertaking of the Wendover Gas Syndicate provides for the transfer being only by agreement; and authority is requested to the money powers obtained by the present measure being applied to the purpose. It is proposed that the standard price shall be 4s. per 1000 cubic feet within a radius of three miles from the Town Hall at Chesham; and in the outer area it is intended that the price shall not at any time exceed 1s. more than the price within the inner area. Under the sliding-scale, penny changes in price will carry variations of dividend to the extent of 2s. 6d. per cent. per annum. Most of the succeeding clauses are of ordinary character, including the prescription of 14 candles as the standard illuminating power, and the "Metropolitan" No. 2 burner for use in testing. The Bill contains stand-by clauses applying to both private installations of gas and to supplies of electricity. They are modelled somewhat on the lines of the Heywood and Warrington precedents; but there are various modifications which justify their reproduction:

> Where any person has a supply of gas laid on by the Company to any premises for which he has at the same time a supply of gas from an installation other than that of the Company, the Company shall be entitled to receive from him as a standing charge, in addition to the price of gas actually supplied to him, a fixed sum to be determined by them, not exceeding £5 per annum: Provided always that, in determining such fixed sum, the Company shall have regard to the probable maximum supply of gas which might at any time be required for such premises, and shall not be entitled to any such standing charge as aforesaid in respect of any premises for which the whole supply of gas afforded by them is taken through a meter having a nominal capacity of less than ten lights.
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> Where any person has a supply of gas laid on by the Company to any premises for which he has at the same time a supply of electricity, the Company shall be entitled to charge and receive from him, in respect of the supply of gas so laid on, such minimum sum as shall be fixed by them, not exceeding 25s. for any one quarter of a year, notwithstanding that the ordinary charge for the gas actually consumed in such quarter would amount to a less sum: Provided always that, in fixing the amount of such minimum charge, the Company shall have regard to the probable maximum supply of gas which might at any time be required for such premises: Provided also that in respect of any premises for which the whole supply of gas afforded by the Company is taken through a meter having a nominal capacity of less than ten lights, the amount of the minimum charge shall not exceed 5s. for any one quarter of a year.

Preceding the ordinary supply-in-bulk clause to authorities in adjacent districts, is one entitling the Company to enter into contracts for a supply of gas for public purposes within the district for a period not exceeding seven years. [*Parliamentary Agents: Messrs. Torr and Co.*]

The Sidmouth Gas Company, Limited, are taking steps to raise themselves to full statutory status. Their capital is at present £9000 in £10 shares, entitled to a maximum dividend at the rate of £10 per annum; £3000 in £10 "A" preference shares, entitled to

a preferential dividend at the rate of 5 per cent. per annum, and to a maximum dividend of 7½ per cent. per annum; and £3000 of "B" preference shares of £10 each, entitled to a dividend of 4½ per cent. per annum. There has also been raised by the issue of debentures £2000 entitled to interest at the rate of 6 per cent. per annum, and £3000 entitled to interest at the rate of 4½ per cent. The Company ask to be empowered to supply electricity within a certain portion of the limits for the supply of gas. The capital proposed is £30,000, whereof £15,000 is to be additional capital, the issue of which is to be subject to the new auction and tender clauses. It is intended to enact that the profits shall be devoted to the payment of 5 per cent. on the "A" preference capital, 4½ per cent. on the "B" preference capital, and 5 per cent. on the original and additional ordinary capital. Then the "A" preference capital and the original ordinary capital, are to be entitled to the further rate of £2 10s. per cent. per annum. On the original ordinary capital and the additional ordinary capital, a further payment is proposed in order to make up the total dividends to respectively 10 and 7 per cent.; and these are the standard dividends. Clauses providing for reserve and special purposes funds appear. Embracing £5000 already borrowed, the Company ask for borrowing powers equal to one-third of the issued capital. The limits of gas supply are defined as the urban district of Sidmouth and the parishes of Salcombe Regis and Sidbury. Following the ordinary provisions as to the construction and maintenance of works, are the clauses referring to charges and dividend. The standard price is contemplated at 4s. 10d. per 1000 cubic feet, with the sliding-scale operating on the ordinary lines. The prepayment meter clause complies with the model, as does also the illuminating power standard of 14 candles, tested by the "Metropolitan" No. 2 burner. A stand-by clause, in terms similar to the Mountain Ash and Rhondda precedents, but including electricity, is inserted as follows:

> Notwithstanding anything contained in the Gas-Works Clauses Act, 1871, or any other Act, a person shall not be entitled to demand, or continue to receive, from the Company a supply of gas for any premises for which he has at the same time a supply of gas from an installation other than that of the Company or a supply of electricity, unless he shall have agreed to pay to the Company such minimum annual sum as will give to them a reasonable return on the capital expenditure, and will cover other standing charges incurred by them, in order to meet the possible maximum demand for those premises, and the sum to be so paid shall be determined in default of agreement by arbitration in manner provided by the Arbitration Act, 1889.

The electricity clauses are of usual form; and among them one finds a request for power to break up certain roads not repairable by the Local Authority, which reminds of the case in which the Redhill Gas Company were involved last year. It is intended that separate capital and revenue accounts shall be kept for the gas and electricity undertakings. [*Parliamentary Agents: Messrs. Torr and Co.*]

In the preamble of the Bill for incorporation of powers which the Whaley Bridge Gas Company, Limited, have introduced, it is seen that the nominal capital of the existing Company consists of £5000, divided into 500 ordinary shares of £10 each, of which 252 shares have been subscribed and fully paid, and 240 shares have been subscribed and £4 per share paid thereon. In addition the Company have expended a sum exceeding £1300 out of income upon the undertaking. In connection with the area of supply, it is remarked that, by the Chapel-en-le-Frith Gas Order, the undertakers under that Order were empowered to supply gas within the parish of Chapel-en-le-Frith, but have never supplied within the part of the parish in the neighbourhood of Whaley Bridge. The limits defined in the present Bill include a portion of the parish in question; and it is submitted as expedient that the powers of the Order referred to should be repealed so far as they relate to the part of the parish of Chapel-en-le-Frith included in the present measure. This is a matter dealt with in the clauses preceding those treating of the incorporation of the Company. The capital powers proposed amount to £10,380, of which £3480 represent the original "A" capital, £1300 "B" original capital (being new capital created by the Act in respect of money expended by the existing Company out of the income on capital account), and £5600 additional capital. Provision is made for the ultimate conversion of the shares into stock. The additional capital it is proposed to issue under the new auction clauses. Borrowing powers are sought to the extent of one-third of the issued capital. The dividends specified are 6 per cent. on the preference capital, 10 per cent. on the original "A" capital, 5 per cent. on the "B" capital, and 7 per cent. on the additional capital. The land and works powers are all in the ordinary form. The maximum price proposed is 5s. per 1000 cubic feet for gas of a standard quality of 14 candles, as tested by the "Metropolitan" No. 2 burner. The prepayment clause is of the usual character, except that there is an addition, for which there is precedent, as follows:

> The Company shall be entitled, if they think fit, to require a deposit of 1s. per quarter for a prepayment meter: Provided that the amount collected from the prepayment meter during such quarter shall be applied in the first place in refunding the said deposit to the person who has paid the same, and subject thereto the deposit shall belong to the Company. Notice of the effect of this sub-section shall be printed on a card to be attached to every prepayment meter.

A stand-by clause appears in the Bill. [*Parliamentary Agents: Messrs. Sharpe, Pritchard, and Co.*]

THE TECHNOLOGY OF POWER GAS.*

The text-book by Dr. Ferd. Fischer, Professor at the University of Göttingen, on the "Manufacture and Evaluation of Power Gas," which is before us, presents a valuable summary of the progress and the present position of the use of various descriptions of combustible gases for the development of power. It contains an immense amount of matter compressed into small compass; and the reader need not fear that the expositions of theory and the practical descriptions of processes and plant will be found to be encumbered with superfluous verbiage. In our subsequent remarks, we propose to follow the sequence which the author has adopted for the treatment of his subject.

An introductory chapter refers to the relative efficiencies of steam and gas engines. It may be stated as a broad conclusion that from 3700 to 4300 calories must be supplied by the fuel to a gas-producer for the development of 1 horse-power-hour through the gas-engine. Some figures are given showing the uneconomical nature of human and animal labour for operations to which mechanical power can be applied. This matter is also referred to in the concluding chapter of the book. There is an excellent exposition of the methods of testing gas for the purpose of valuing it for use for the development of power. The rules for efficiency trials of gas engines and producers that are issued by the Association of German Engineers and allied institutions in 1906, are quoted; and some remarks thereon are offered by the author. In regard to the direct determination of the calorific power of gas, the author describes a convenient still-water calorimeter of his own design, and also refers briefly to the Junkers calorimeter. In regard to the latter, he quotes authorities for the belief that the results obtained with it may be as much as 10 to 15 per cent. below the true calorific power of the gas. He says that, when a gas contains only a small proportion of methane, it appears that this constituent is not completely burned in the Junkers calorimeter. In support of this view of the author's, we may mention that a case has recently come to our knowledge in which the calorific power of a producer gas was determined simultaneously by analysis, by the Junkers calorimeter, and by the Boys calorimeter. The determination made by the Junkers calorimeter gave considerably lower results than those of the other two methods, which were in close agreement. It would thus appear that it is preferable, in order to ensure complete combustion of the gas, to use a luminous flame, as is done in the Boys calorimeter, rather than a bunsen flame of the kind employed in the Junkers apparatus. It may be, however, that an improved form of bunsen burner ensuring more thorough admixture of the gas and air before combustion would overcome this objection to the Junkers and other forms of gas calorimeter in which atmospheric burners are used.

The next section of the book deals with the raw materials employed for the manufacture of power gas. They are taken in the following order: Wood, peat, brown coal or lignite, and coal. A number of recent analyses of typical coals and anthracites, mostly, but not exclusively, from German and Austrian pits, are quoted. There is a good deal of matter with reference to the spontaneous ignition of coal, and the precautions which have been suggested by various authorities to avoid overheating and ignition of coal in ships' bunkers and coal-stores. The next section of the work relates to the carbonization of wood, peat, lignite, and coal, and constitutes a useful summary of the behaviour of these materials when carbonized in the laboratory and on the working scale. Different types of carbonizing plant are, however, not discussed by the author.

The gasification of carbon by interaction with oxygen (air), carbonic acid, and water, forms the subject of the next section of the book. The theoretical foundations of the producer-gas processes are exhaustively set out. The next section is on coal gas as made both on gas-works and in coke-ovens. It is brief, and does not include any description of the different types of carbonizing plant. Gas from recovery coke-ovens receives more thorough treatment than gas from retorts, probably because it is considered that since coke-oven gas is a bye-product, it is more likely to be available for power production at a low cost. The necessity for the thorough purification of the crude coke-oven gas before use in gas-engines is pointed out; and a washer-scrubber and an ordinary type of oxide purifier are described. The bottom tier of grids in the purifier is charged with broken coke, instead of with oxide of iron.

The following section relates to water gas, and is very brief. The Dellwik process, as such, is referred to only in three lines, in which it is pointed out that Dellwik's German patent has been annulled. The next section, which is the longest and most important in the book, deals with mixed gas, or, as it is more commonly known in this country, Dowson or semi-water-gas. After referring to the effects of the addition of steam to the air supply to gas-producers, the author briefly discusses the composition of the fire-brick linings of producers, and the necessity for using a lining which is not acted upon or does not flux with the ash of the particular fuel employed. He then goes on to describe the modern modifications of the Dowson producer for the gasification of anthracite or coke with air under pressure; and a number of types of such producers are illustrated and referred to in detail. The author then proceeds to suction-gas producers, of which like-

* "Kraftgas, seine Herstellung und Beurteilung," von Dr. Ferd. Fischer, Professor an der Universität Göttingen. Leipzig, 1911; Otto Spamer.

wise a large number of the more recent types are described and illustrated. The German State Regulations for the erection and working of suction-gas plants are quoted at the conclusion of this section. The mixed gas plants so far described are those intended for the consumption of anthracite or coke; but in his next section the author passes on to refer to plant for the production of mixed gas from bituminous coal. This section appropriately includes an account of the Mond generator. It is pointed out that, according to a trial of which details are given, 23·6 per cent. only of the water or steam introduced into this generator is decomposed for the production of gas.

A section follows describing various processes and schemes for the manufacture of power gas from refuse fuel, such as coal and coke breeze, pan coke, &c. The best known in this country of the types of producer referred to under this heading is the Duff. The next section relates to producers for the manufacture of gas from brown coal or lignite. These are, of course, of comparatively little interest to British engineers, though some of the types that are described are applicable also to the gasification of peat, which forms the subject of the next section of the book. The concluding portion of this section refers to Frank's schemes for the utilization of peat for gas making in Mond producers; and the results of the trials carried out at Winnington and Stockton are quoted. Peat containing 42 to 47 per cent. of water yielded gas containing 17·3 to 18·8 per cent. of carbonic acid; while peat containing a higher proportion of water yielded gas still richer in carbonic acid. Peat containing 1·05 per cent. of nitrogen has been found to yield 4 per cent. of its weight of sulphate of ammonia; and peat containing 2·8 per cent. of nitrogen, 11 per cent. by weight of sulphate of ammonia. These yields correspond with a conversion of over 80 per cent. of the nitrogen in the peat into ammonia. They are apparently, however, the results only of special trials on a working scale, and not of continuous working over a long period. There is a short section on the production of power gas from wood; the Riché producer being the chief one described.

A fairly long section of the book is devoted to blast-furnace gas and its utilization for power purposes. The washing and scrubbing plant necessary for the cleansing of the gas are described, as well as some typical exhausting fans. The gas required for the Cowper stoves and boiler-firing naturally is not subjected to such thorough purification as that which is to be consumed in gas-engines. The average cost of purification is stated to be about one-fortieth of a penny per 1000 cubic feet. It is said that at the present time over 500,000 H.P. is obtained from blast-furnace gas in Germany by means of large gas-engines.

There is a concluding section in which reference is made to the estimated available water power in different countries of Europe. Opportunity is taken in this section also to supplement the information given in previous sections on various points by additional matter derived from later sources. The book concludes with a brief index and a tabular statement of the numbers of the German patent specifications referred to in the text. There is no index to the names of the various authorities quoted by the author, or of the different types of plant described. The book should prove very useful to all interested in the production and use of producer gas and the various descriptions of low-grade power gases. The nomenclature adopted may prove rather troublesome to some readers; and the author might with advantage have used one term throughout for the same substance. As it is, we find on one page the three terms "carbonic acid," "CO_2," and "carbon dioxide" used in the text, without any reason given for the variety. Similarly, "marsh gas" and "methane" are used alternately on another page. It would have been better to have adhered to one term or the other in each case throughout.

Masonic.—It has been arranged that the consecration of the Murdoch Lodge, No. 3480, will take place at Birmingham on Thursday, the 23rd of February. The Marquis of Hertford will be the Consecrating Officer, assisted by the officers of the Provincial Grand Lodge of Warwickshire. The Marquis is Provincial Grand Master of Warwickshire.

The Gas and Electricity Tests at Canterbury.—We have received from Mr. H. C. Page, the Engineer of the Canterbury Gas and Water Company, some further particulars in regard to his competitive tests of gas and electric lighting, to which reference was made in the "Journal" for the 20th ult. (p. 837). It may be mentioned that he is using a 110-candle power "Vesta Veritas" gas-burner, working at a pressure of about 3 inches, and a 100-candle power Osram electric lamp. The results of the 120 hours' test up to Dec. 24 were: Gas, 1s. 9½d.; electricity, 4s. 3½d.

Commercial Year Books.—In the summer of last year, we received from Messrs. Bemrose and Sons, Limited, a copy of the first issue of the Commercial Year Book of the Leeds Chamber of Commerce. A twofold object was sought by its publication—viz., to furnish traders in all parts of the world with particulars of the manifold industrial resources of the city, and to supply the members of the Chamber, in a brief and compendious form, with the information as to the regulations of Foreign and Colonial Governments in relation to British merchants doing business in their territories. A similar book has now been issued by the Leicester Chamber of Commerce. A feature of each work is the printing in English, French, Spanish, and occasionally German, of the names of the different trades. These productions should fill a useful place in the commercial world of each town.

MUTUAL COMPENSATION SCHEMES.

When noticing in the "Journal" for the 13th ult. the Home Office Blue-Book of statistics of workmen's compensation for 1909, it was remarked that the "contracting-out" schemes in operation would be found set forth in the Annual Report of the Chief Registrar of Friendly Societies, by whom these arrangements between employers and employed have to be certified. This report for 1909 has now been issued, over the signature of Mr. J. D. Stuart Sim. The scales of compensation in connection with such schemes must be not less favourable to the workers and their dependants than those contained in the 1906 Act. If the workmen contribute, the scheme must confer benefits at least equivalent to those contributions in addition to the benefits to which the employees would have been entitled under the Act; and a majority by ballot of the workmen must be in favour of the scheme. The Registrar may, however, consider the scales of benefit as a whole; they need not be identical with those set forth in the Act. He can also take into consideration extra benefits conferred under a scheme, and not mentioned in the Act.

The returns for the year ending Dec. 31, 1909, show that during this period there were 32 schemes in active operation under the Act of 1906. This is the same number as in the preceding year. They are divided under the headings of railways, factories, mines, and quarries. The Great Eastern—the only Railway Company included in the list—have a scheme which was adopted by 29,226 workmen, out of a total of 32,906 employed. The men contributed in the aggregate £6074 during the year; the Company, £11,151. The payments made on death were £3662; and during incapacity, £11,645. At the end of the year, the balance of funds amounted to £3320. There were 23 deaths from injury, and 3139 cases of incapacity. The average contribution of each workman appears to be 1d. per week. The twelve schemes adopted in connection with mines were agreed to by 17,024 workmen, out of a total of 17,511; their contribution being £7329, and that of the employers £10,829. The total payments were: On death, £2120; during incapacity, £10,221; and for other benefits, £3080. The funds at the end of the year were £52,056. There were 14 deaths, and 3649 cases of incapacity. The average contribution of each of the workmen was 8s. 7d. In regard to quarries, there was one scheme in operation; and this was adopted by the whole of the 785 workmen, who contributed £253; the share of the employers being £782. There was only one death during the year, and 189 cases of incapacity. The payments made were small; and the balance of funds at the end of the year was £980. The average contribution of each workman was 6s. 5d. In England and Wales, there were sixteen schemes connected with factories of various kinds; and these were adopted by 16,616 workmen (out of a total of 16,843), who contributed in the aggregate £1210 during the year, while the employers gave £8672. Payments on death were £1049; during incapacity, £5066; for other benefits, £2410. The funds at the end of the year were £9404. The number of deaths resulting from injury was four; and in two of these six dependants were left, to some of whom pensions were granted, in addition to the money returned as paid. The number of cases of incapacity from injury was 1305. For the year, the average contribution of each workman was nearly 1s. 6d. In four of the schemes, however, the whole of the contributions were paid by the employers. In addition, there were two schemes connected with factories in Scotland, which were adopted by the whole of the 3301 workers, who contributed £504, to which the employers added £1925. The payments on death were £459; during incapacity, £1139; for other benefits, £85. At the end of the year, the funds amounted to £5817. There were three deaths from accident during the year; while the number of cases of incapacity was 364. The average contribution of each workman came to nearly 3s. 1d.

Among the factories—which include various industries—there are still but two gas undertakings in connection with which mutual compensation, or "contracting-out," schemes are in operation. These, of course, are the South Metropolitan and the South Suburban Companies. In the case of the South Metropolitan Company, the whole of the 6265 workmen employed joined the scheme; their contributions for the year to Dec. 31, 1909, amounting to £114, and those of the Company to £1603. The payments on death and to dependants came to £710; but there was only one death from accident in the period covered by the returns. The cases of incapacity numbered 206, in connection with which £763 was paid. Other benefits absorbed £244; and these payments equalled the contributions (£1717) made by the Company and the employees. In the case of the South Suburban Company, too, the scheme was joined by the whole of the 631 men employed; their contribution being £29, and that of the Company £216. On death and to dependants £46 was paid; there having been one death during the year. The cases of incapacity numbered 40, in connection with which payments amounting to £167 were made. Other benefits aborbed £32; and these sums equalled the contributions (£245) of the Company and the employees. It is estimated that the maximum amount payable under the Act in connection with the cases of incapacity would have been £137, as compared with the £167 actually distributed under their scheme by the South Suburban Company.

It is stated in the report that, in the aggregate, particulars were returned of 8558 cases of incapacity completed during the year by weekly payments, in respect of which the sum of £23,265 was

paid. In 17 per cent. of the total number, the duration of incapacity was one week and under; the cost being £878, or an average of 12s. for each case. In 20 per cent. of the total cases, the duration was over one week, and under two weeks; the cost being £2034, or £1 3s. 2d. per case. There were 74 cases (or 0·86 per cent. of the total number) in which the incapacity exceeded 26 weeks; and the cost to the funds was £29 14s. 7d. for each case, or 13s. 2d. per week of incapacity. In addition to those already mentioned, 29 cases of incapacity were settled either by payment of lump sums after a period of weekly payments, or by payments of lump sums only, thus making the total number of cases completed during the year 8587, and their cost £25,788. From eleven returns furnishing information as to the estimated maximum amount that would have been payable under the Act, it seems that the workmen would have been entitled to receive £2935; whereas the sum actually paid to them under the respective schemes was £3632. In the aggregate, the 32 schemes were adopted by 66,952 workmen, whose contributions during the year amounted to £15,370; those of the employers being £33,359. There were 45 fatal accidents, and 8646 cases of incapacity.

LOCAL INCOME AND EXPENDITURE.

Finances of Urban District Councils.

THERE were given in the last number of the "JOURNAL" (p. 916) some figures with reference to the finances of the borough councils for the twelve months ending March 31, 1908; and attention may now be devoted to dealing in a similar manner with the succeeding instalment of the Local Taxation Returns—that is to say, Part VI., which covers the same period. This portion summarizes the accounts of urban district councils other than town councils.

The number of urban district councils in England and Wales, for districts other than boroughs, dealt with in the report is 813. This shows an increase of two when compared with the previous year; there having been three new councils formed, while one has disappeared in consequence of having been added to another urban district. Of course, they are on a smaller scale, but otherwise the financial transactions of the urban district councils are in many ways similar to those of the borough councils. Such "reproductive" undertakings, that is to say, as gas, water, electric lighting, markets, and tramways and light railways, enter largely into the accounts. It is stated in the returns that the total receipts from these undertakings were sufficient to cover 95·5 per cent. of the expenditure on the concerns, including all charges in respect of loans. A further large part of the transactions relates to works of private improvement, the cost of which is recovered by the councils from owners or occupiers of property; while the financial statements also include receipts from sewage farms, baths and wash-houses, slaughter-houses, hospitals, cemeteries, &c. Of the total number, 55 councils acted as local elementary education authorities.

The receipts of the urban district councils, excluding receipts from loans, amounted during the year 1907-8 to £11,085,679, including £1,591,718 on account of elementary education. The total receipts of the councils for the preceding year were £10,724,289. These receipts, it may be mentioned, included sums received from county councils under the provisions of the Local Government Act, 1888, and also grants under the Agricultural Rates Act, 1896. The latter Act, however, does not apply to general district rates, which, in the case of the urban district councils, produced 85·4 per cent. (£5,147,795) of the total raised by rates (£6,026,610); and hence the amount of the grants is small in comparison with that of the total income from rates. Among the other receipts were: Gas-works, £971,241 (as against £887,996 in the preceding year); water-works, £693,310 (against £663,151); electric light undertakings, £331,097 (against £282,893); and tramways and light railways, £240,298 (against £208,716). Attention is drawn in the Blue-Book to the fact that, in making comparisons of the totals of urban district council financial items, it should always be borne in mind that the authorities included are subject to variation from year to year—fresh bodies being continually added to, and others removed from, the list. So far as could be ascertained from the returns made, the receipts in respect of gas-works, just quoted, for the year 1907-8, included £719,555 from gas-rentals, and £219,129 from the sale of residual products. The receipts in respect of water-works included £476,307 from water rates, rents, or charges for domestic purposes within the respective districts of the councils owning the water-works. The amount raised during the twelve months now under review by means of public rates accounted for 54·4 per cent. of the total receipts; while the receipts from the principal undertakings which produce revenue (water, gas, electric lighting, markets, and tramways and light railways), together with those in respect of private improvement works, represent rather less than 24·5 per cent. of the income of the councils.

In the twelve months ending March 31, 1908, the total expenditure of the councils, excluding that defrayed out of loans, was £11,064,969, as compared with £10,640,892 the preceding year; so that there was an increase on this side of the accounts of £424,000. About £70,000 more appears under the head of education; and loan charges are £56,000 heavier. The following items of expenditure (in which charges for interest and repayment of loans are not included) may be noted: Public roads and streets, £1,677,621 (as against £1,658,858 the previous year); education £1,424,134 (against £1,355,426); gas-works, £672,131 (against £604,695); public lighting, including public lighting by electricity, £504,255 (against £489,481); sewerage and sewage disposal, £455,655 (against £455,061); water-works, £398,156 (against £381,368); tramways and light railways, £159,182 (against £134,834); electric lighting, not being public lighting, £173,039 (against £129,687); and £2,943,601 for repayment of principal (otherwise than out of sinking funds and redemption funds), payments to sinking, &c., funds, and interest on loans, as compared with £2,887,588 in the preceding year. Of the principal and interest so paid, and allocations to sinking funds, £245,971 was on account of gas-works, £384,950 of water-works, £173,292 of electric lighting, and £134,123 of tramways and light railways. The aggregate length of main roads maintained and repaired by the councils at the commencement of the year 1907-8 was 2376 miles; and the expenditure under this head amounted during the twelve months to £466,669, or at the rate of practically £196 10s. per mile. The total length of roads other than main roads maintained and repaired was 11,516 miles; the expenditure being £885,585, or an average cost of nearly £77 per mile.

The expenditure of the district councils out of loans (including certain sums spent in anticipation of loans) during the year 1907-8 amounted to £2,265,938. Of this, £136,442 was on gas-works, £244,331 on water-works, £148,313 on electric lighting, £146,482 on tramways and light railways, and £465,969 on sewerage and sewage disposal works. The total expenditure out of loans during the year was less than that of 1906-7 by £569,549. Large decreases appear in the expenditure on account of tramways and light railways, elementary education, and electric lighting. The expenditure on street improvements and gas-works, however, shows an increase. The total amount of the loans raised during the year was £2,203,660, including the following amounts: Gas-works, £135,169; water-works, £157,596; electric lighting, £132,043; tramways and light railways, £102,923; sewerage and sewage disposal works, £444,232. The amount of loans raised was less by £590,037 than that raised the previous year. Among other items, decreases appear in the amounts raised for tramways and light railways, water-works, and sewerage and sewage disposal works; but gas-works show a considerable increase.

The amount actually repaid during the year in respect of loans (including payments out of sinking and redemption funds, but excluding unexpended balances of loans applied to the repayment of principal) was £1,688,028. The outstanding loans at March 31, 1908, amounted to £35,948,107. Of this debt, £8,562,441, or 23·8 per cent., was for purposes of sewerage and sewage disposal; £5,430,912, or 15·1 per cent., for water-works; £3,857,094, or 10·7 per cent., for education; £3,489,832, or 9·7 per cent., for gas-works; £3,091,782, or 8·6 per cent., for street improvements; £2,346,955, or 6·5 per cent., for electric lighting; and £2,091,401, or 5·8 per cent., for tramways and light railways. The loans outstanding in respect of what are termed the "reproductive" undertakings, and for works of private improvement, represent a large proportion of the debt; the aggregate for water-works, gas-works, electric lighting, tramways and light railways, markets, and works of private improvement being no less than £14,393,674, or 40 per cent. of the total debt. Loans outstanding increased during the year 1907-8 by £325,800, which, it may be remarked, is the smallest increase in the course of a year since 1895-6. In respect of several services or purposes, the amount of the loans outstanding at the end of the year now dealt with was slightly less than twelve months before. The amount remaining at the end of the twelve months in sinking and redemption funds for meeting loans repayable in this way was £576,077. The sum paid into the funds during the year was £218,510; and the amount taken out of them and applied to the repayment of principal was £197,390.

According to the census of 1901, and taking into account the alterations of area made since that time, the total population of the 813 urban districts other than boroughs was at March 31, 1908, 6,817,300. The total assessable value of the districts for the purposes of the general district rates, or other rates out of which the general expenses of the councils were defrayed, was £32,927,686. The rates raised by the councils, other than for purposes of elementary education, amounted to £5,303,565, which was equivalent to 3s. 2·66d. in the pound on the total assessable value of the districts for the purposes of such rates. This figure compares with 3s. 2·92d. in 1906-7. The total sum raised by the councils by means of rates during the year for purposes of elementary education was £723,045, representing a rate of 1s. 3·71d. in the pound calculated on the assessable value for the purposes of the poor rate of the districts in which the amount was raised.

It is to be gathered from comparative tables which accompany the returns that the receipts of urban district councils, acting as urban sanitary authorities, burial boards, harbour, pier, or dock, &c., authorities, and port sanitary authorities, from all sources (except elementary education), other than from loans, increased from £8,880,437 in 1903-4 to £9,497,007 in 1907-8; and the total expenditure not defrayed out of loans (on purposes other than elementary education) increased from £8,827,792 in 1903-4 to £9,483,026 in 1907-8. The receipts from public rates for purposes other than elementary education (including grants under the Agricultural Rates Act, 1896), which in 1903-4 amounted to £5,069,144, rose in 1907-8 to £5,307,448. Receipts from the most important undertakings which yield revenue—water-works, gas-

works, electric lighting, tramways and light railways, and markets —have shown large increases, it is pointed out, during the last four years; while the annual expenditure in connection with these undertakings has also increased considerably. The total receipts from, and the expenditure out of, loans diminished considerably in each of the years 1905-6, 1906-7, and 1907-8; the decrease being particularly noticeable as regards loans for works of sewerage and sewage disposal, electric lighting, and water-works. In recent years, it is remarked in the Blue-Book, there has been a distinct slackening in the rate of increase of the debt of the urban district councils. The outstanding loans of the councils at the end of the year 1900-1 amounted to £23,064,280; while at the end of the year 1903-4, they were £32,415,809; and at the end of the year 1907-8, £35,948,107. Thus the total debt of the urban district councils rose in the four years ended March 31, 1904, by £9,351,529, or 40·5 per cent.; whereas in the four years to March 31, 1908, it rose by only £3,532,298, or 10·9 per cent. In 1903-4 the outstanding loans for electric lighting undertakings amounted to £1,894,195; in 1907-8, to £2,346,955. During the same period, however, the outstanding loans on gas-works only increased from £3,293,091 to £3,489,832.

THE IRON AND STEEL TRADES IN 1910.

The improved trade returns that have been much in evidence lately are conducive to a more cheerful feeling than it has been possible to entertain on some recent occasions when approaching the study of reports of the accomplishments of specific industries during the preceding twelve months. To many people at the beginning of last year there appeared to be signs that, at any rate in some directions, things were on the mend; and it is shown by the annual review of Messrs. Bolling and Lowe that in the iron and steel trades this optimism has been justified.

"A decided improvement on 1909, and a general advance in prices in many directions," are the words in which the firm sum up the record of the position of trade for the year which has just drawn to a close. At the same time, it is pointed out that the progress has been intermittent, and a suspension has several times occurred. In fact, at no period was the improvement in the nature of a boom. Various increases in prices which occurred at the commencement of the year were regarded as indicative of a general move forward; but in the early summer there was a noticeable cessation of activity, though prices remained fairly firm. When the Board of Trade returns were issued, they disclosed an appreciable increase in the exports of iron and steel for the first seven months of the year, in spite of a short strike in July on the North-Eastern Railway which paralyzed trade in certain quarters for a few days. On the labour aspect, the reviewers remark that, without attempting any close estimate of comparison as to the actual figures that might have been obtained, it is fair to assume that a very much brighter condition of things would have resulted but for the strikes which have thrown such a gloom over the commercial world. Alluding to the stubborn industrial war that has been waged in the North of England and South Wales, attention is drawn to the undeniable fact that the resistance displayed to any influence from the Trade Union leaders towards conciliatory measures becomes an increasing danger in these labour troubles. In one matter, a set-back in 1910 has to be noted. For the first time we have allowed ourselves to be outstripped by Germany in the quantity of steel exported; and, say Messrs. Bolling and Lowe, "however sanguine we may be that a reversal of this is probable, the difficulty of regaining ground once lost is universally conceded." The exports of iron and steel up to Sept. 30, 1910, were: Germany, 3,575,000 tons; Great Britain, 3,554,000 tons. The following approximate prices, per ton, are quoted: Steel bars: 1910, £6; 1909, £5 7s. 6d. Boiler plates: 1910, £7 2s. 6d.; 1909, £6 10s. Joists: 1910, £5 15s.; 1909, £5.

The pig iron market, we learn from the report, kept fairly steady during the past year, prices having varied little more than 2s. 6d. per ton over the whole of the period. An advance is, however, looked for now that the strike in the North is settled. What little there is to record on the subject of rails is by no means cheerful; for this section of the trade has been remarkably quiet, and there has been a great falling off in the tonnage exported. Prices have undergone little variation. Considerable apprehension is manifested with regard to the growth of competitors, who, it is realized, may snatch away important customers, with every likelihood of retaining them. Works are cited, in Hankow, New South Wales, and India, which have joined the ranks of producers; and with the projected erection of large works on the West Coast of America, it is said, "the worst trade enemy, over-production, is well in sight." In galvanized sheets business was good, though prices kept fairly equable; the average quotation for No. 24 gauge being £11 5s. To Nov. 30, 548,060 tons were exported, against 441,455 tons for the same period in 1909. There was an increase of nearly 40 per cent. in the exports to India. In one respect, South Wales was especially favoured, inasmuch as the conditions in the tin-plate trade were almost those of a boom.

In addition to the iron and steel trades, Messrs. Bolling and Lowe in their review touch upon other metals. As to copper, it is stated that the outstanding feature of the past twelve months has been the remarkable persistence of demand from all classes of consumers—a demand which has not only taken up all the metal coming into sight, but has actually made inroads on the visible stocks both in America and Europe. Prices have been reasonable, the figures showing an extreme fluctuation of slightly over £9 a ton—between £62 1s. 3d. and £52 15s. a ton. The opinion is expressed that the position of the metal seems to be perfectly sound; and we are told that this year will see Russia for the first time an exporter of electrolytic copper—the development of properties and plants in that country having now reached a point at which an exportable surplus is available. There has been some revival of previous rumours that a big American merger is in contemplation. The establishment of a copper market in Hamburg, where 10-ton contracts form the basis of dealing, is an event which may ultimately, it is thought, affect the volume of business transacted in London. Tin was during the latter part of the year, it seems, to a greater or less extent under the influence of manipulation at the hands of a syndicate of speculators who sought with considerable success to obtain control of the article. Whether the price of £175 per ton, or over, is in any way justified by the intrinsic position, may, the reviewers think, be doubted; but it is admitted that the party now in the ascendent are pretty confident, and that their success may sooner or later bring about a general buying movement. The excellence of the Welsh tinplate trade has, of course, been a point very much in favour of the bulls; but American advices are far from being of a reassuring character. The lowest point touched last year for cash tin was £143 12s. 6d. per ton, and the highest £175.

Messrs. Bolling and Lowe as usual give our exports and their value of pig iron and iron and steel for the eleven months ending Nov. 30 of each of the past three years. They are as follows: Pig iron: Year 1908—1,209,452 tons, value £3,809,616; 1909—1,052,776 tons, value £3,373,402; and 1910—1,119,478 tons, value £3,823,726. The total exports of iron and steel were: Year 1908—3,904,061 tons, value £34,818,428; 1909—3,996,622 tons, value £35,226,505; 1910—4,354,434 tons, value £39,829,712.

The reviewers conclude their task in the following words: "It is with no feeling of undue pessimism that we hesitate to express too hopeful a view of the near future, as we feel sure that a cessation of the two great strikes should set in motion a great deal of work which has for some time lain dormant. But unless there is a more settled condition of affairs in the political world, in the United States, and in some Continental trade centres, we think we shall have to be satisfied with present conditions for some little time, though there may be an improvement when we get well into 1911."

FUTURE GAS SUPPLY OF VIENNA.

The contracts between the Corporation of Vienna and the two Gas Companies who still own works there—viz., the Imperial Continental Gas Association and the Austrian Gaslight Company —expire at the end of this year. The works in the districts of Döbling, Baumgarten, Fünfhaus, Floridsdorf, and Gaudenzdorf belonging to the Companies will then cease to supply gas; and the distributing systems connected therewith will be taken over by the Municipality according to a valuation. From Jan. 1, 1912, the Corporation will provide the whole of the gas supply of Vienna. The present municipal works at Simmering are to be enlarged to the fullest extent possible, and new works are in course of construction at Leopoldau. It is estimated that the requirements for the whole of Vienna in 1912 will be about 33½ million cubic feet of gas per diem, or (say) 6070 million cubic feet per annum. The maximum output of the Simmering works, when enlarged, and with all reserve plant in action, will be about 30 millions per diem. The extensions will be completed at these works, and the new plant ready for use by next autumn.

The site for the new works at Leopoldau is about 109 acres in extent; and about half the area will be covered in the first instance. It adjoins the Northern Railway; and sidings for waggons will be provided on the east side of the works. The plant will at first be for a make of 1410 million cubic feet per annum; but the site will be capable ultimately of accommodating plant for a make of 35 millions per diem, or 7050 millions per annum. According to the "Journal für Gasbeleuchtung," the new works should be ready to start operations next autumn. The gas made there will be pumped from the holder at the works by means of a turbine blower through a high-pressure wrought-iron main to a holder station in the Brigittenau district. At this station there is a gasholder, which was to have been finished in 1910, having a capacity of 8,825,000 cubic feet. This holder therefore ranks as the largest on the Continent, and is distinguished by having a tank with an arched or bulged outer casing. This is the tank referred to in the opening lines of the paper read by M. Bonnet at the last meeting of the Société Technique du Gaz en France, a translation of which appeared in the "Journal" for July 5 last (p. 37).

Mr. O'Connor's Lectures on Gas Manufacture and Lighting.—Readers may remember that, in the early part of 1909, Mr. Henry O'Connor delivered a course of five Keith Lectures before the Royal Scottish Society of Arts; his subject being "Gas Manufacture and Lighting." The lectures, which were shortly noticed in our columns at the time, have been reprinted as a pamphlet, published at the offices of the "Journal."

GAS SUPPLY FROM CENTRAL STATIONS IN GERMANY.

Utilization of Coke-Oven and Colliery Gas.

THE Engineering Supplement to "The Times" has lately contained articles on "Power Supply in Germany." They were brought to a close last Wednesday with an article on "Gas-Works for Overland Supply," some portions of which are of special interest to our readers. These may be briefly indicated.

The writer begins by stating that the most important development in gas engineering at the present time in Germany consists in the utilization of coke-oven gas, as produced at the collieries of Westphalia and other coal basins, and its transmission by means of large conduits to the towns and villages of wide adjacent areas. He points out that the idea of central gas-works is not new, as in 1903 an experiment of the kind was made on a small scale at Lübeck, which contracted to supply gas to the seaport of Travemünde, some 15 miles away; and there are now at least 40 gas-works in Germany which act as supply centres for surrounding districts, for the most part, however, very limited in area. What is new is the commercial use which is being made on a large scale of a waste product of the coke-works, and its distribution direct from the pit mouth. According to Herr Förster, of Mülheim, something like 212 million cubic feet of gas of the quality usually supplied for consumption are daily given off and wasted by the coke-ovens of the Ruhr basin. This represents an annual waste of more than 70,000 million cubic feet, which, at the low figure of 7d. per 1000 cubic feet, would amount to £2,000,000.

It is stated that as yet only a beginning has been made with the utilization of the enormous store of light and power now wasted by the Westphalian collieries. The use of coke-oven gas for illuminating purposes is, however, making rapid headway. The first transactions of the kind on a large scale were those between the collieries controlled by Herr Stinnes and the towns of Essen and Mülheim, which began by buying coke-oven gas direct in order to mix it with that produced in their own works, to which it proved quite equal in quality. So successful was the experiment that these two towns have since decided to close their gas-works and depend entirely on colliery gas. The contract of the Municipality of Essen is with the Victoria Matthias Colliery Company, acting in the name of other colliery companies, and is to run for at least ten years. Colliery gas will be supplied in bulk in any quantity needed at the price of about 8½d. per 1000 cubic feet. Similarly, the adjacent town of Bochum has agreed to discontinue its gas-works, and obtain a supply from Krupp's Hannibal and Hanover Collieries. Other towns have either closed their works or are about to do so; and negotiations are pending with respect to others. The Municipalities of Barmen, Velbert, and Heiligenhaus have concluded contracts for a supply of gas. The contract for the first-named town will take effect from the 1st of April next, when the municipal works will be closed. About 600 million cubic feet of gas will be furnished, at a price ranging from 1s. 3½d. down to 1s. per 1000 cubic feet. The latest contract with Velbert provides for a sliding-scale of prices varying with the price of coal; but the figure will always be lower than the cost of producing gas at the municipal works.

The writer of the article states that at the present time Herr Stinnes, whose name has already been mentioned, is negotiating, as representative of an Essen enterprise, with a number of towns and villages with a view to supplying them with colliery gas. A scheme is being promoted for the establishment of a large gas-generating station, from which, if needful, the whole of the industrial district of Westphalia could be supplied. A number of towns have provisionally agreed to take a supply of gas and close their works; and it is expected that the price to be charged them —viz., 1s. per 1000 cubic feet—will leave an ample margin for profit. A similar movement is in progress in the Saar coalfield. In connection with the central gas-works established by the Bismarck Smelting Works Company, there are already 38 miles of gas-pipes; and the Company are competing successfully with the large electricity works in the district. The writer mentions that, for the present, the more important municipalities equipped with thoroughly modern plant have not been seriously menaced by this movement, even when they are situated on the outskirts of a coalfield, like Cologne and Düsseldorf. On this point he says:

> Not only has the introduction of vertical retorts and other recent improvements rendered great economy possible in the cost of production, but these towns are effectually protected by the trade monopoly which they enjoy within their administrative areas. Where a town lies far away from the coal measures, like Berlin—which supplies gas to various small communes many miles from its boundaries north and east—it may be a considerable time before the long-distance transport of colliery gas will benefit the great mass of consumers. Nevertheless, the question of bringing this gas within reach of all the large centres of population is largely one of initial expense. The gas exists in virtually unlimited amount, and can be remuneratively marketed at the mere cost of collection and conveyance.

The writer closes with some remarks as to the potentialities of this "overland" supply of gas. He thinks there is no reason why the two great coal and iron districts of Germany—Westphalia and Silesia—should not be able to supply at least a large part of the country with all the light and power needed for industrial, domestic, and public purposes. As regards gas, instead of every town and village importing coal from distant collieries in order to produce its own illuminant in comparatively small quantities uneconomically on the spot, the supply would be obtained from central receiving and distributing works, conveniently situated, linked up with the producing collieries. All the advantages of production on a large scale would in this way be secured, to the great gain of the consumers; while the familiar experience of prices varying by 50 and 100 per cent. in contiguous areas of supply would cease to exist. With regard to electricity, corresponding advantages and economies would, he says, be offered, both to industrial and domestic consumers. He admits that the idea of thus revolutionizing the gas and electrical engineering industries is a big one. But, he says, "big minds are working at it; and it would be unsafe to regard its eventual realization as chimerical or even doubtful."

THE VOLATILE CONSTITUENTS OF COAL.

By MAURICE J. BURGESS and RICHARD V. WHEELER, D.Sc.

AN investigation into the nature of the volatile constituents of coal has been made by Messrs. Burgess and Wheeler in connection with the British Coal Dust Experiments, which are being conducted at Altofts by the Mining Association of Great Britain, and on which a preliminary report has recently been issued.

The object of these experiments has been the study of the phenomena occurring during the explosive combustion of mixtures of fine coal dust and air, with a view to discovering a means of preventing coal-dust explosions in mines. It was considered that in connection with the study of these phenomena it would be valuable to have information as to the nature of the volatile constituents of coal, because it was believed that there was an obvious relationship between the behaviour on heating of the volatile matter in a particular coal and the degree of inflammability of the dust of that coal. It should be possible to draw a distinction between coal dust of different degrees of inflammability, or liability to propagate explosion, by determining: (1) The temperature at which gas is most readily evolved; (2) the stage in the heating at which the most inflammable mixture of gases makes its appearance; and (3) the shortest time of heating that will allow of the distillation of any gas at all. Ultimately it is hoped that investigations of these points may afford definite information regarding the composition and chemical constituents of coal. The present investigation has been carried out with the problem of coal-dust explosions alone in mind; but the results obtained are of more general interest. The following particulars are abstracted from a paper presented to the Chemical Society during the last summer vacation, by Messrs. Burgess and Wheeler, and published recently in the "Journal" of the Society.

The authors' investigations on the destructive distillation of coal at different temperatures having for their ultimate object the elucidation of the nature of coal, at present only enable them to indicate the bearing of this part of their work on the subject. It appears to them that:

1.—With all coals, whether bituminous, semi-bituminous, or anthracitic, there is a well-defined decomposition point, at a temperature lying between 700° and 800° C., which corresponds with a marked increase in the quantity of hydrogen evolved. With bituminous coals, the increase in the quantity of hydrogen evolved falls off at temperatures above 900° C., but with anthracitic coals it is maintained up to 1100° C.

2.—Evolution of hydrocarbons of the paraffin series ceases practically entirely at temperatures above 700° C.

3.—Ethane, propane, and butane, and probably higher members of the paraffin series, form a large percentage of the gases evolved at temperatures below 450° C.

The authors advance the suggestion that coal, of whatever geological age, contains a compound which undergoes decomposition at temperatures above 700° C. (under atmospheric pressure), and yields hydrogen as its principal gaseous product. It seems probable to them also that the same compound is responsible for the hydrocarbons of the paraffin series that make their appearance at low temperatures. As to the technical application of their results, they state that in the manufacture of lighting gas there is as yet no decided opinion as to the best carbonizing temperature to use, and that the influence of that temperature on the nature and quantity of the products of distillation has not been thoroughly investigated. They also point out that the efficiency of the steam-boiler depends largely on the quantity and the nature of those constituents of coal which can be gasified at a comparatively low temperature, and that the chief loss of efficiency arises from the cooling effect of the boiler surface on the gases evolved from the coal, whereby the temperature is reduced below the point necessary for complete combustion. The temperature and rate of distillation of gases from coal vary with its nature; and the cooling effect of a boiler surface will vary also with the nature of the gases evolved. It is possible, the authors say, that the smoke-producing tendencies of some varieties of coal largely depend on the last factor.

The authors draw attention to experiments on the "Nature of Volatile Matter of Coal as Evolved under Different Conditions" made by Messrs. H. C. Porter and F. K. Ovitz for the Technological Branch of the United States Geological Survey, of which an account was given in the "JOURNAL" in 1908 [see Vol. CIV.,

p. 343]. They quote from that account the composition and the results of distillation of samples of Ziegler (Illinois) and Connellsville (Pennsylvania) coal given in Tables VI., XI., and XII. [*loc. cit.*, pp. 345 and 346]. The Connellsville coal is one which it has been found in practice is burned with difficulty without smoke; and the figures reproduced show that this coal yields a larger quantity of "smoke-producing" gases—viz., benzene, ethylene, and the higher homologues of methane—than the Ziegler coal at the lower temperatures. [In Messrs. Porter and Ovitz's paper, however, it is pointed out that at a temperature of 440° C. in the coal the Ziegler coal produces more smoky gases than the Connellsville coal, and it is only at 565° C. and higher that the Connellsville coal produces more smoky gases.] Messrs. Burgess and Wheeler incline to the belief that the "smoke-producing" constituents consist practically entirely of the higher hydrocarbons of the paraffin series, because they have isolated small quantities of propane and butane from the gases evolved from coal at low temperature, and they obtained evidence of the presence of higher members of the series. These gases very readily decompose with deposition of carbon at temperatures below 600° C.; while ethylene deposits very little carbon on decomposition at this temperature.

The samples employed in Messrs. Burgess and Wheeler's investigations were prepared by pulverizing about 330 lbs. of screened nut coal in a special disintegrator, and collecting about 2¼ lbs. of the fine dust formed during the operation. This dust was passed through a sieve of 240 holes per linear inch, and stored in screw-topped bottles. The quantity of coal taken for each distillation test was 2 grammes, dried at 107° C., and intimately mixed with 3 grammes of previously ignited white sand. The mixed charge of coal dust and sand was placed in a thin platinum boat B (fig. 1), 5 inches long, which would slide easily

Fig. 1.—Platinum Retort and Connections.

into a tubular platinum retort R, 8½ inches long, and 0·67 inch in internal diameter. The open end of this retort was silver-soldered into a gun-metal collar with a wide flange to which was bolted, by six screws, a similar flange attached to a gun-metal tubular mouthpiece L. One flange was provided with a groove into which a projecting ring on the other flange fitted, and was made vacuum-tight by compression upon a washer of asbestos and graphite. An open-ended platinum tube S, packed with ignited asbestos fibre, was fitted into the retort and mouthpiece before the joint was made between the latter and the retort. This tube, the wide part of which was 3⅛ inches in length and formed a good sliding fit in the retort as shown, served as a scrubber for the extraction of tar.

After the mouthpiece had been connected to the retort, it was joined by stout rubber pressure tubing to a mercury pressure-gauge and a gasholder, of 2 litres capacity, sealed with a mixture of equal volumes of glycerine and water. A three-way glass tap and two other glass taps on the connections admitted of the retort and connections being first exhausted of air and being connected with the gasholder as soon as the pressure of the gases evolved when the retort was heated reached that of the atmosphere. The retort was heated in a platinum-wound electric resistance tube furnace, which, with a current of a little more than 1 ampère at 200 volts, would attain a temperature of 1400° C. The retort was inserted in this furnace until the boat containing the coal was in the zone which previous measurements had shown to be that of the highest, and of uniform, temperature.

The temperatures employed were all of them measured by means of a platinum and platinum-rhodium thermocouple, which traversed the furnace lengthwise, with its junction in the centre, and insulated by an unbroken length of silica quill tubing. The temperatures recorded were therefore the retort temperatures; but a special experiment, where a thermo-couple was embedded in the coal, showed that the temperature of the latter reached that of the retort in 1½ to 2 minutes from the start of the experiment. After the retort had been run into the furnace—previously brought to the desired temperature—heating was continued for a definite period, usually 75 minutes, and the retort was then withdrawn, allowed to cool, and the gases remaining in it were exhausted by means of a mercury pump, and passed into the gasholder. The retort and mouthpiece were then disconnected, and the tar scrubber and the boat removed and weighed.

The gas collected in the gasholder was analyzed by means of a modification of the apparatus devised by Messrs. Bone and Wheeler [see the "Journal," Vol. CI., p. 160], in which the constituent gases were absorbed in the following order by the reagents named: (1) Ammonia, by 10 per cent. sulphuric acid; (2) benzene, by sulphuric acid of 1·9 specific gravity; (3) sulphuretted hydrogen, by an acidified solution of copper sulphate; (4) carbonic acid, by a solution of caustic potash; (5) oxygen, by a strongly alkaline solution of pyrogallic acid; (6) acetylene, by an ammoniacal solution of silver chloride; (7) ethylene, by a solution of bromide and potassium bromide; and (8) carbonic oxide, by an ammoniacal solution of cuprous chloride. The hydrogen was estimated by passing the residual gas into exhausted glass bulbs containing "oxidized" palladium precipitate heated in a water bath to 90° C. The gas was kept in the heated bulbs for ten minutes; and after the bulbs had cooled, the residual gas was withdrawn by means of a mercury pump and measured. The loss of volume was reckoned as hydrogen. The residual gas from this operation was then exploded for the determination of the remaining constituents. Records were taken of the rate of evolution of gas; but these volumes were not corrected to normal temperature and pressure. The total quantity of gas evolved was calculated to the corresponding volume of nitrogen-free gas at 0° C. and 760 mm. per gramme of ash-free dry coal. From 1 per cent. to 4 per cent. of nitrogen was usually found by analysis in the gas; but as this might be partly due to the complete exclusion of air from the retort connections, or else to error in the analysis, it was assumed that the gases were free from nitrogen, and the proportions of the other constituents were calculated as percentages of nitrogen-free gas. The tarry matter and the total volatile matter were calculated as percentages of the ash-free dry coal.

Details are given in the paper of the experiments made with four samples of coal, of which the origin, proportion of ash, and composition in percentages of the ash-free dry coal are stated in Table I.

Table I.—*Description and Composition of Coals Tested.*

Sample.	I.	II.	III.	IV.
Type	Bituminous	Bituminous	Semi-bituminous	Anthracite
Origin	Altofts Silkstone	Abertillery	Penrhycyber	Pontyberen
Ash per cent.	5·51	7·65	3·5	3·9
Carbon, per cent.	80·50	85·72	90·72	92·66
Hydrogen ,,	5·45	4·93	4·23	3·14
Oxygen ,,	9·70	7·34	1·25	2·20
Nitrogen ,,	1·42	1·09	2·99	0·99
Sulphur ,,	2·93	0·92	0·81	1·01
	100·00	100·00	100·00	100·00

The rate of evolution of the gas at different temperatures of distillation is shown in Table II., which gives the volumes, measured in cubic centimetres at atmospheric temperature and pressure, of the gas evolved from a gramme of the coal. The same table also shows the total volume, at 0° C. and 760 m.m., of gas evolved at different temperatures per gramme of ash-free dry coal, and the volumes of the principal constituents of the gas. The proportions of total volatile matter to the ash-free dry coal are also shown in percentages by weight, as well as the proportions of tarry matter produced.

The volumes of hydrogen, methane, ethane, and carbonic oxide evolved at different temperatures are also shown graphically in the two diagrams—fig. 2 (Coal No. 1) and fig. 3 (Coals Nos. III. and IV.).

Coal I.

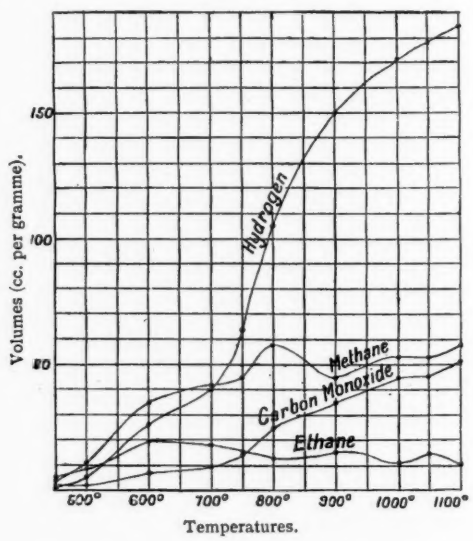


Fig. 2.

The coke resulting from Coal No. 1, up to and including distillation at 800° C. was dull black in colour, and had a tarry odour; and that from Coal No. II. was dark and compact. Above 800°, the coke from both these coals was greyish white and lustrous. Coal No. II did not swell so much on coking as Coal No. I. The coke from Coal No. III. did not appear to cake at all until a temperature of 800° had been reached; and it swelled very little. There was no change in the appearance of Coal No. IV. on heating, except that at 1100° some of the particles appeared to have caked slightly.

The authors point out that the data obtained indicate that there is a critical period in the decomposition of all the coals

TABLE II.—*Rate of Evolution of Gas at Different Temperatures and Total Volume and Composition of Gas Evolved (c.c. per Grm. of Coal), and Tar and Total Volatile Matter (per Cent. by Weight).*

Distillation Temperature °C.	500°.				600°.				700°.				800°.				900°.				1000°.				1100°.			
Coal No.	I.	II.	III.	IV.	I.	II.	III.	IV.	I.	II.	III.	IV.	I.	II.	III.	IV.	I.	II.	III.	IV.	I.	II.	III.	IV.	I.	II.	III.	IV.
1st minute of distillation c.c. (uncorrected)	..	..	..	..	20·0	..	..	..	25·0	30·0	..	..	72·5	50·0	45·0	25·0	112·5	100·0	87·5	60·0	150·0	160·0	150·0	125·0	..	237·5	275·0	187·5
2nd " "	..	..	..	..	12·5	..	..	..	12·5	17·5	..	..	37·5	35·0	30·0	12·5	62·5	52·5	60·0	47·5	72·5	65·0	75·0	50·0	..	22·5	25·0	37·5
Total, 0 to 5 minutes	..	..	..	..	47·5	35·0	..	..	62·5	75·0	50·0	7·5	150·0	125·0	115·0	70·0	222·5	190·0	200·0	122·5	252·5	250·0	255·0	202·5	282·5	280·0	317·5	242·5
" 5 " 10 "	..	..	..	..	11·0	15·0	..	..	15·0	15·0	12·5	20·0	30·0	25·0	27·5	25·0	25·0	25·0	22·5	22·5	30·0	22·5	20·0	20·0	15·0	20·0	10·0	7·5
" 10 " 15 "	..	..	..	..	6·5	10·0	..	..	7·5	12·5	10·0	..	12·5	25·0	15·0	10·0	7·5	10·0	7·5	5·0	7·5	5·0	5·0	7·5	2·5	2·5	5·0	5·0
" 15 " 30 "	..	..	..	..	12·5	10·0	..	..	17·5	10·0	10·0	..	13·5	15·0	25·0	15·0	10·0	12·5	15·0	10·0	12·5	10·0	5·0	2·5	12·5	7·5	5·0	12·5
" 30 " 45 "	..	..	..	..	7·5	5·0	..	..	5·0	10·0	5·0	2·5*	6·5	10·0	7·5	.. 5·0*	7·5	2·5	7·5	.. 2·5*	7·5	7·5	2·5	..	7·5	2·5	..	7·5*
" 45 " 75 "	..	..	..	..	5·0	5·0	..	..	5·0	2·5	5·0	..	5·0	7·5	5·0	..	5·0	10·0	5·0	..	12·5	5·0	2·5	..	2·5	2·5	2·5	..
" 0 " 120	30·0	32·5	15·0	..	..	..	57·0	25·0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total gas evolved c.c. at 0° and 760 m.m.	29·9	33·5	13·00	..	99·0	83·0	56·0	23·5	124·0	135·0	94·0	44·0	218·0	208·0	193·0	133·0	268·0	254·0	248·0	193·0	305·0	296·0	288·0	230·0	327·0	312·0	333·0	272·0
Hydrogen " "	5·0	2·70	2·05	..	26·4	20·8	20·6	6·0	40·55	46·95	40·7	20 8	105·8	105·7	115·2	91·3	149·3	144·95	162·5	136 0	172·0	177·0	201·3	173·5	185·2	189·45	242·7	201 5
Methane " "	11·25	21·60	8·45	..	34·9	39·2	27·3	10·6	42·90	62·45	43·2	16·1	56·9	59·5	54·7	28·0	45·5	55·5	51·2	30·8	53·5	57·25	41·6	26·2	57·5	58·65	42·8	24·1
Ethane " "	8·25	3·70	1·80	..	19·0	10·35	2·6	0·2	17·70	5·75	2·0	0·9	13·3	9·80	4·8	1·2	16·1	13·35	4·0	2·0	10 8	9·15	8·5	3·4	11·1	5·60	6·0	0·4
Carbonic oxide " "	1·95	1·65	0·60	..	7·0	5·35	2·2	1·3	9·80	10·05	3·6	3·5	25·8	20·35	12·2	8·9	36·6	28 55	23·1	18·0	46 0	40·15	29·4	22·3	51·8	40·55	36·9	39·8
Ethylene " "	0·45	..	..	..	1·7	..	..	..	2·00	..	..	..	1·95	.	..	..	3·7	..	..	..	5·0	..	..	..	6·0	..	..	..
Total volatile matter, per cent.	18·79	13·4	3·54	..	28·37	21·17	7·71	3·57	32·30	25·68	10·47	3·76	36·30	28·96	14 40	6·18	38·05	30·14	16·75	7·82	38·30	31·36	17·34	8·77	38·83	31·56	19·00	12·50
Tarry matter " "	9·05	7·0	0·99	..	13·66	10·02	2·10	0·22	14·08	7·36	2·85	0·40	13·50	10·56	2·56	0·95	12·25	9·67	1·73	0·80	10·40	9 19	2·07	0·22	9·06	8·21	Not estimated	

* With Coal No. IV. evolution of gas had ceased at 60 minutes, and the total volume evolved between 30 and 60 minutes was measured without subdivision.

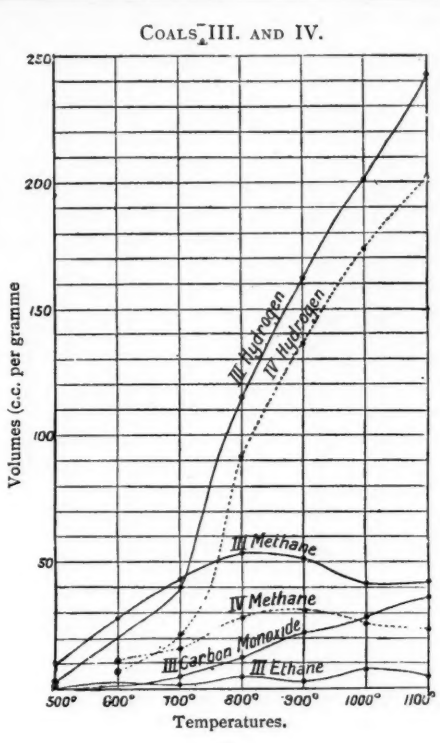


Fig. 3.

between 700° and 800° C.; this critical period being indicated by the abrupt or sudden increase in the quantity of hydrogen evolved. The total quantity of gas evolved at 800° C. is in some cases nearly, and in other cases more than, double that evolved at 700°. There is also a marked increase in the total volatile matter shown at about 750° C., at about which temperature also the quantity of tarry products reaches a maximum. There is a comparatively high percentage of ethane in the gases evolved at the lower temperatures; but, broadly, this percentage decreases progressively as the higher temperatures of distillation are reached. The actual quantity of ethane evolved, however, varies comparatively little with the temperature of distillation after 600° or 700° C. has been passed.

It is suggested that the ethane found in the products of distillation at high temperatures has been evolved during the initial period of slow heating up of the coal on the introduction of the retort into the furnace, and has been swept out of the retort, without undergoing decomposition, by the gas which is subsequently evolved at a rapid rate. Messrs. Bone and Coward have shown that the thermal decomposition of ethane is fairly rapid at 675° C., and is practically instantaneous at 1000° C. [See "JOURNAL," Vol. CIII., p. 322.] The nature of the reaction responsible for the evolution of the hydrogen, which is evolved rapidly between 750° and 900° C., is discussed by the authors. The hydrogen cannot be produced at the expense of the methane, because the total quantity of methane varies comparatively little at the different temperatures; and it has been shown by Messrs. Bone and Coward that only about 50 per cent. of a sample of methane was decomposed on one minute's heating in a porcelain tube at temperatures below 1100° C.; while at 785° C. (which about corresponds with the retort temperature for the maximum rate of evolution of hydrogen), only 10 per cent. of methane was decomposed when it was heated for one hour. No trace of carbon

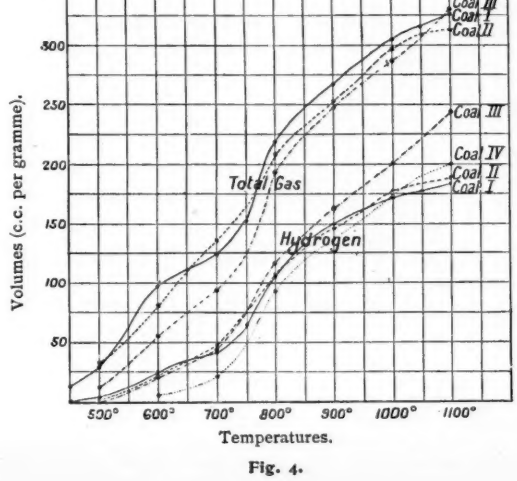


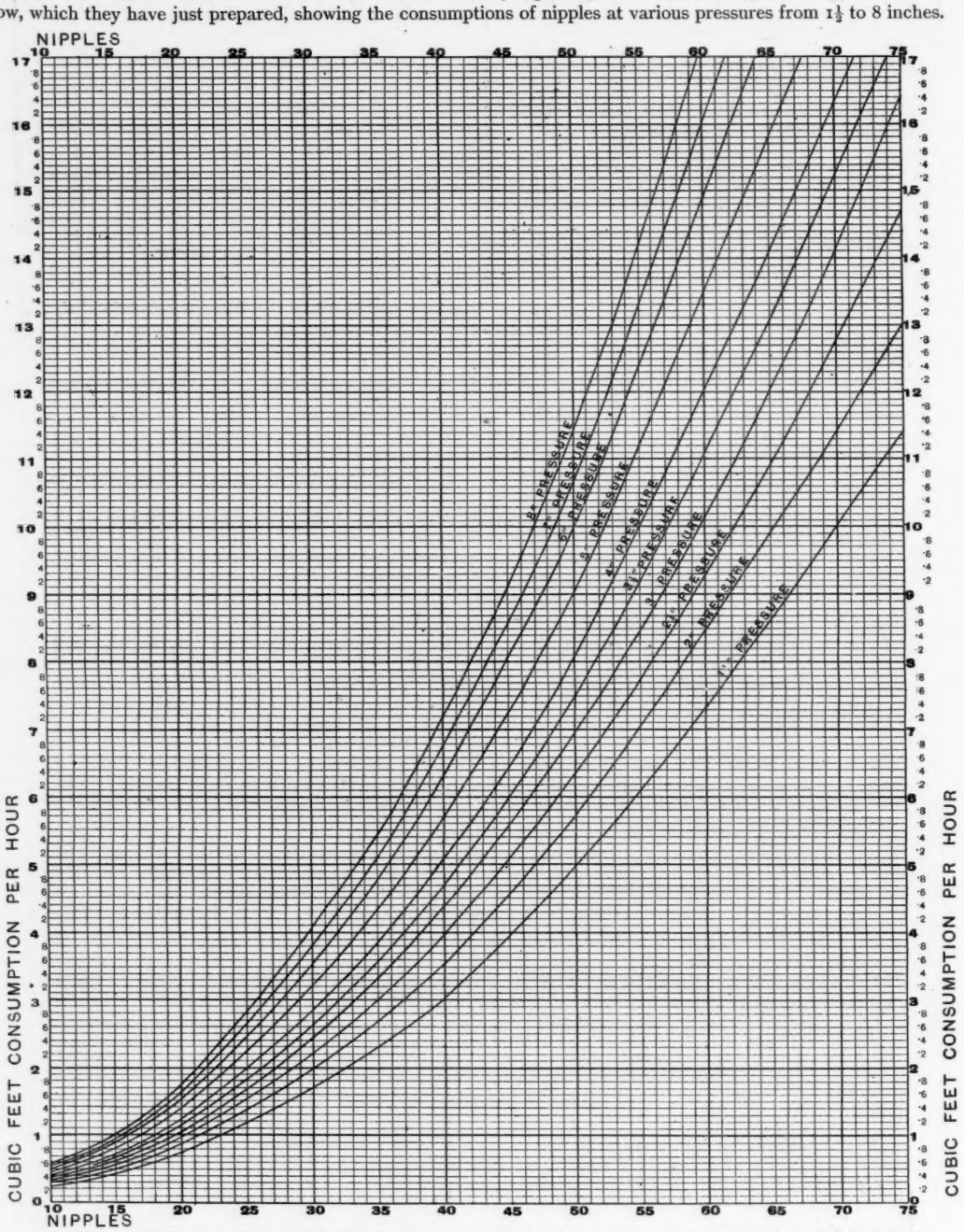
Fig. 4.

deposited in the hard and lustrous form, almost metallic in appearance, which is characteristic of the carbon deposited by the thermal decomposition of methane, could be detected when the temperature of distillation was below 900° C., though at 1050° C. a quantity of such carbon, just sufficient to weigh, could be brushed off the sides of the platinum boat and retort. The quantity of olefines was insufficient to furnish by their decomposition the largely increased quantity of hydrogen, while on decomposition below 800° C. olefines yield a greater quantity of methane than of hydrogen. The authors incline to the belief that one or more of the higher hydrocarbons of the paraffin series in the volatile products undergoes rapid decomposition at about 750° C., yielding chiefly hydrogen and carbon. At lower temperatures, the products are methane, ethane, and hydrogen.

The rate of increase in the quantity of hydrogen evolved is maintained with Coals Nos. III. and IV. up to the highest temperature employed—viz., 1100°—whereas in the case of the other (bituminous) coals, the rate of increase falls off above 900° C. This is shown by the curves for the volumes of total gas and of hydrogen evolved at different temperatures given in the diagram fig. 4. The total quantity of gas evolved by the distillation of the semi-bituminous coal No. III. is greater than that evolved by the two bituminous coals Nos. I. and II. at 1100° C., though less at 700°. It is suggested by the authors that the first products of distillation of anthracitic coals are probably not such as will allow of recombination to any great extent of free unsaturated residues to form more complex molecules, as is apparently the case with bituminous coals yielding greater quantities of tarry matter.

A CONSUMPTION CHART FOR MANSFIELD'S INVERTED INCANDESCENT GAS-BURNERS.

We have received from Messrs. Mansfield and Sons, Limited, of Derby Square, James Street, Liverpool, a copy of a new chart, reproduced below, which they have just prepared, showing the consumptions of nipples at various pressures from 1½ to 8 inches.



CURVE OF NIPPLE CONSUMPTION PER HOUR OF COAL GAS ('5 SP. GR.) AT PRESSURES SHOWN.

[Nipple Sizes represent Circular Holes, One-thousandth of an Inch Diameter.]

Accompanying the chart are the following multiplying constants for other specific gravities than those shown: Sp. gr., '8—Constant '790; '7—'845; '6—'913; '5—0'; '4—1'118; '3—1'291; '2—1'581.

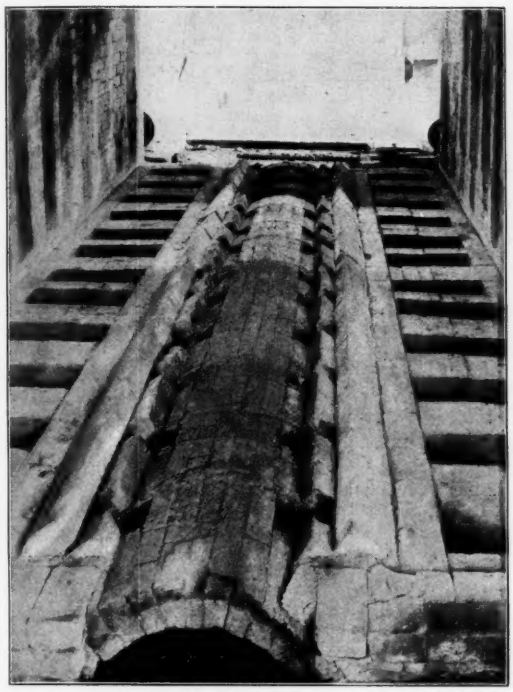
The use of these constants is shown by the following example: No. 55 nipple consumes, at 2 inches pressure, 7 cubic feet of gas per hour. What is the consumption at '6 sp. gr.?

$$7 \times \cdot 913 = 6 \cdot 391 \text{ cubic feet.}$$

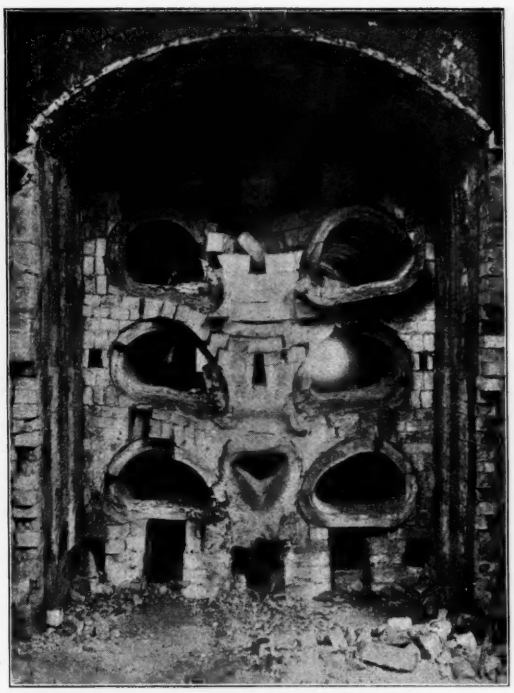
[If any of our readers would care to have a copy of the chart, Messrs. Mansfield state that they will be pleased to forward one on receipt of a request to do so.]

DISCUSSION ON DR. LESSING'S PAPER ON "REFRACTORY MATERIALS AND THEIR TESTING."

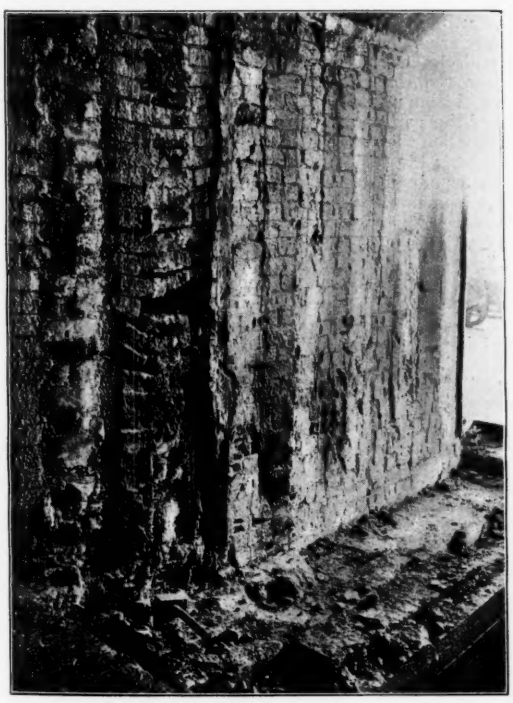
There is given below a report of the discussion which took place on the paper read by Dr. Rudolf Lessing before the Liverpool Engineering Society on the 14th ult.—see "JOURNAL" for Dec. 20, p. 841.



Producer Arch after 1500 Days' Working.



Failure of Retort-Setting through Inferior Bricks and Blocks.



Division Walls of Retort-Bench, Showing Failure through Bad Design—Combustion Chambers against Walls.

REPRODUCTIONS OF SOME OF THE PHOTOGRAPHS EXHIBITED BY DR. LESSING.

The PRESIDENT (Mr. Edward Allen), after moving a vote of thanks to the author, observed that the subject of the paper was somewhat exceptional, being perhaps more in the nature of a chemical than an engineering one. At the same time, it was a most difficult thing to say what engineering really was. Engineers needed the assistance of every branch of science; and chemistry was becoming a more and more important subject in the requirements of the engineer. In the carrying on of all great manufacturing concerns, the engineer who had not some knowledge of chemistry, or who did not avail himself of the services of a competent chemist, would be hardly likely to prove successful. The subject of refractory materials entered largely into the working of many industries. In connection with all of their industries, furnaces were required; and though it might seem to be a simple matter to talk of refractory materials, yet some discrimination required to be used in the class of brick employed. In the Pottery district, this was a very vital matter; and the question of the co-operation of manufacturers and users was of great importance in industries other than the gas industry. Almost every town had its refuse destructor; and in respect of this apparatus, the question of the fire-clay material was of the utmost importance. He understood that the difficulty in connection with destructors lay in the fact that all kinds of material were used, and that the resulting dust had a wonderfully evil effect upon the fire-clay itself. The

subject dealt with by Dr. Lessing was one of special interest to gas engineers. In the earlier days, coal gas was made in retorts of iron; and the heat employed was comparatively low. But fortunately someone had tried the effect of fire-clay in place of iron, with the result that greater heats were possible and more gas was distilled from a ton of coal. The gas was of a high quality, and no special desire had been expressed for an increase in yield. But, as was well known, the illuminating power of gas had come to be of less and less importance; and the object of gas engineering was to obtain the maximum amount of heat out of a ton of coal. The two cases which had been shown on the screen represented an experience which had been of very great value. The engineer must necessarily experience some failures; and the experience gained from failures was often of very great service in the design of subsequent work. Their German competitors had led the way in this matter of fire-clay retorts. The reason was, not that they had better materials, but that they had the scientific knowledge which enabled them to make the right mixture for obtaining porosity. The Englishman was alive to the importance of the subject, and was determined not to be behind in the race; and he (Mr. Allen) was prepared to say that this country would shortly be second to none in the production of fire-clay goods.

Mr. G. N. Shawcross, referring to the slides which had been exhibited, said he would like to ask of what kind of material the bricks were composed which had failed in the remarkable manner shown. All bricks were, of course, refractory within a degree. The author had not referred at any length to basic materials, but had appeared to confine his remarks chiefly to the subject of fire-clay. He (Mr. Shawcross) was responsible for a number of furnaces; and the ordinary fire-clay brick did not come into use very much. With the higher form of brick, the silica brick, there was no shrinkage; its tendency being to expand. It was therefore necessary to maintain the furnaces at a high temperature, and at a very constant degree of temperature; and presumably this was the reason why silica brick was not used to any great extent in connection with gas-retorts. He was anxious to know whether the adoption of basic materials was even a remote possibility. As to the question of crucibles, it was, as the author had stated, necessary to compromise. The crucible would stand alternate heat and cold without breaking; but it would not stand the fusion. He understood that a very much finer grain was required than in the case of the ordinary crucible. Probably this was the reason why tilting furnaces were now so popular. With regard to the subject of the test slabs, he would like to ask whether the tests were carried out in the maker's works. Occasionally, a cargo of bricks was received hard-baked, and another as soft as clay; and he would like to know whether the tests mentioned were carried out on the cargoes of bricks as they left the furnaces. He would like to know whether it was suggested that brick manufacturers produced two or three qualities—one intended for furnaces, another for boiler-fronts, and which might be dense or porous as the case might be—and whether they were made in the same manner or differently. He had yet to learn that makers altered their clay to suit the different requirements for which the bricks were intended to be uesd.

Mr. J. Bond (Southport) thought that the firms responsible for the manufacture of fire-clay material would find it necessary to consult the scientist more and more, in order to obtain such material as would withstand the increasing temperatures required in the various industries; and by the aid of science, and such men as the author of the paper, chemical and physical knowledge of fire-clay material would be increased. The physical properties probably played a greater part than the chemical properties. He had tested fire-clay materials, and had found that, though the chemical composition of Yorkshire and Derbyshire silicas were similar, yet the expansion and contraction of the material was very different. He had tried several furnaces, but had not been satisfied, because he had been unable to obtain a very high temperature; and he was therefore erecting at the present time a furnace which would be worked by an oxy-acetylene flame playing directly upon the fire-clay material. He hoped that this would prove a very handy form of taking temperatures. He had been very much interested in the reference to the electrical furnace in which the author had employed a voltage of 70 to 80 and 130 amperes. He would be interested to know if this was continuous current, or whether it could be done as well by alternating current. He would also be glad to know the size of the test slab which was employed by the author for ascertaining the amount of expansion and contraction of the fire-clay material.

Mr. Samuel Glover (St. Helens) considered there was ample evidence that engineers required to know where they stood in the purchasing of fire-clay materials. They were too ready to accept a fire-clay brick as a fire-clay brick. In the case of a certain Yorkshire brick, which was stamped with the letters "H.B.," he knew that engineers bought this brick in large quantities because of these letters, and yet they had not known whether the letters were an abbreviation for "hard burnt" or "Halifax best." This fact was evidence of the amount of knowledge possessed by some engineers, who were very particular about the quality of iron and steel, in regard to refractory material upon which so much depended. The combustion which went on in tubular boilers was a matter upon which the whole success depended; and the refuse destructor's successful working depended very largely on the suitability of the brick for the peculiar work required to be done, as the combustion which went on in a refuse destructor using town's refuse was one of very mixed chemical gases. The subject of gas engineering should perhaps not now be touched upon very largely. A great deal of the ignorance had been fostered by the producers of fire-clay materials themselves; and it was necessary that not too much credit should be given to their German friends in the matter of fire-clay materials. From Belgium came some very fine fire-clay material, the superiority of which lay in the chemical composition of the bricks, and in the fact that the material was mixed better, and they stood more wear and tear than any English bricks had been able to stand. The owners of this country's fire-clay materials had trusted too much to the assertion that Nature had provided them with the best possible material. Engineers, when dealing with refractory materials, required to take carefully into consideration the nature of the operations for which they were to be used; and the difficulties could only be overcome by owners of fire-clay material recognizing the fact that the excellent article with which Nature had provided them required to be properly treated and prepared. The question of burning was a matter which ought to be very carefully considered, to ensure that, in a delivery of bricks, some should not be only half-burnt and some well burnt. The fire-clay material, before being delivered to the user, ought to be submitted by the maker to as high a temperature as it would be required to stand in actual work. The failure of an installation to withstand the destructive influence of a very high temperature ought not necessarily to be taken to reflect upon the fire-clay material. In the test-furnaces, the circumstances ought to approach as closely as possible to those in which the materials would be used. In most cases, the bricks were not manufactured to stand the direct action of the flame, and were not required to do so; and in the exceptional instances where they were called upon to do so and failed, their behaviour ought not to be too severely criticized.

Mr. Hugo Flinn remarked that he would be glad of the author's help in connection with a particular case. It was seldom that the opportunity was given of obtaining specialized information on a subject of this kind. The case was that of an ordinary furnace of a water-tube boiler, with an arch running about 7 feet long by 5 feet wide, about 18 inches high in the middle, and about 6 inches lower at the sides. In actual burning, it had been found that the corners of the arch were burnt away. It was quite local action, working in from about 8 inches from the side of the arch, and burning away the centre support. It was apparently due to unequal distribution of fire in the grate. Extremely good coal on the sides produced a high temperature; and a little further in the worst coal was used. It was quite an easy matter to alter the distribution; but it was not the best thing for the boiler. The centre of the arch remained intact, while the sides and support of the arch were entirely cut away. He took it that two different kinds of brick were required in this particular arch. Referring to the point which had been raised as to the extreme difference in the chemical action of the material that was burned in refuse destructors, he might mention that in a single destructor in Liverpool, within one week, among the fuel burned were two cart-loads of dead dogs and 90 tons of salted tobacco; and, during windy weather, it was not an uncommon experience to get large numbers of bricks in the fuel—possibly parts of the houses which had been blown down in the district.

Dr. Lessing, after thanking the members present for the kind manner in which they had received his paper, observed that he had greatly appreciated the invitation of the President to submit a contribution on the subject of refractory materials, and had considered it better to prepare such a paper as would prove a means of stimulating interest in the subject, rather than one giving full and complete information, which would not be possible in the time and space at his disposal. The contributors to the discussion had not made very great demands on his own refractoriness, because they had appeared to agree with most of what had been said. He did not think he could add very much to the President's remarks. In reply to Mr. Shawcross, the bricks which had collapsed, as shown on the slide, were probably ordinary fire-bricks, but exactly what kind he was unable to say. As a matter of fact, they were old settings put to a new use, and had been subjected to very much higher temperature than that for which they had been originally constructed; and therefore it was the design of the settings that was responsible for the failure, rather than the material itself. Where the failure occurred a material of comparative low refractoriness might have stood.

The President explained that the matter was an experiment; being an attempt to mix Stourbridge clay with silica. The trial blocks stood the test satisfactorily; but the material became plastic, and failed under ordinary working conditions.

Dr. Lessing (continuing) referred to Mr. Shawcross's complaint that materials other than fire-clay had not been dealt with. As a matter of fact, some of the basic materials had been mentioned in the paper; but in the time and space at his disposal, he had felt compelled to practically confine himself to certain materials which were of the greater importance, and which offered the greatest inducements in demonstrating the theoretical points that had to be considered in the testing of all the materials. But so far as the chemical and physical properties of the materials were concerned, there was little difference in the testing. That ordinary fire-clay would not be satisfactory in a furnace, was practically understood, though there were some varieties that might stand up to a certain point. In those cases purely basic or acid material had to be used; and with these the chemical action of the material was the principal one. The molten metal had an action which was entirely a chemical process, and might be compared with the

fluid in a steel furnace to the action of a glass beaker that would yield some of its contents to the action of the water that was boiled in it. With crucibles, the same thing happened. As Mr. Shawcross had said, crucibles of close texture had to be used on account of the phenomenon that most metal oxides would penetrate into it. With reference to Mr. Shawcross's question as to whether the tests of the material were carried out at the maker's works, the matter of testing was entirely one between the buyer and the seller. If the user of the material would insist on certain specific material being delivered, as he ought to do, he would have a chance of carrying out the tests either before or after delivery, whichever was convenient; and it was desirable that such tests should become more common. Under the standard specification in connection with gas-works, the buyer was permitted to send a duly authorized representative to the works to see that everything was satisfactory. Where manufacturers had several qualities of material, or where they would pay attention to the supply of different grades and qualities for different purposes, it was a matter for consideration by the buyer in the first instance. Unfortunately, many manufacturers paid but very little attention indeed to this point; and it was an urgent necessity that they should be compelled to do so. It would certainly be to their own interest to come into touch with the user, and see the uses to which the materials were to be put; and, on the other hand, the buyer would in this way have the opportunity of finding out what would be the most useful material under any particular conditions. Since the question of Continental methods had been introduced, he might say that the largest German makers had not a pound of clay within 50 miles of their premises, and obtained their supplies from all parts of the Empire. It was not sufficient to depend entirely on the material provided by Nature; and one of the objects of his paper was to bring home to both users and manufacturers the necessity for classifying their materials. With reference to the matter that had been mentioned as to relying on the fusing-point, he thought that he had stated with sufficient clearness that this was not the only criterion to be considered. The first condition was, of course, that the material should be refractory. But, on the other hand, it ought to be tested under the circumstances in which it was subsequently to be used. Clays varied largely in the matter of fusion; and some English clays which had a very low fusion-point were quite suitable for building material right up to, or within a very narrow limit of, this fusion point, whereas other clays, while they might be more refractory and have a higher fusing-point, might not be suitable for any purpose at a little distance below this point. They might become soft at a temperature far below their actual fusing-point. Therefore, an absolute standard could not be laid down for all these properties. He agreed with Mr. Bond that the physical properties of the material were more important than the chemical properties, although the chemical analysis was a great help in ascertaining the characteristics of the material and its probable action in use. On the other hand, most materials were not employed for their chemical action, and the chemical properties were only corollaries of the physical ones. The physical conditions might be quite different under equal chemical circumstances. On the subject of furnaces, he was not quite certain as to whether the oxy-acetylene flame had ever been suggested before. The question depended mainly on the kind of furnace employed. It was not always the absolute temperature obtained, but rather the temperature to which the test-piece was submitted. He was not certain if it would be a fair thing to test refractory materials in an oxy-acetylene flame. With regard to the electric furnace, he believed that either kind of current could be used. In either alternating or continuous current, the trouble was to transform down to the necessary voltage—requiring a bulky transforming plant. The questions raised by Mr. Glover brought them back to what had been said many times before—that fire-brick was not necessarily fire-brick, and fire-bricks did certainly vary a great deal. Mr. Glover also referred to the high quality of the Belgian material. This had, of course, always been considered a very good one. The Belgians had started very early to take advantage of the scientific discoveries that had been made from thirty to forty years ago, and had always kept abreast of all new developments. On the question of burning and testing before delivery, he quite agreed with Mr. Glover that any article should be burned to at least as high a temperature as that to which it would be exposed in actual use, and, if possible, to a higher temperature. The contraction and expansion must reach a certain maximum; and this maximum should be reached before the material was put to actual use. If the bricks for a gas-retort were burned high enough and long enough, this maximum would be reached, and no further contraction could take place. As a matter of fact, slight expansion might occur; but this was not of very great importance. In testing for refractoriness, the atmosphere should be the atmosphere which would be maintained in actual use. As a rule, an oxidizing atmosphere was preferred for tests; and it was, of course, of great importance where a direct flame was used, as the flame which actually played on the test-piece would have to be of an oxidizing nature. Mr. Flinn's question was one which was difficult to answer without knowing the actual circumstances. What he believed really took place in most boiler-furnaces was that the material used was not one that was fit for the greatest temperature that occurred. He was possibly mistaken; but it might be simply a question of insufficient refractoriness of the material on those parts where the high temperature actually occurred, though the same material might be sufficiently refractory for the parts where there was a comparatively cool atmosphere. On the other hand, it was also largely a physical question. On the corner of the furnace-arch there was a rubbing action of the gases, which was one not to be lightly considered—and not only the gases themselves, but also the flue-dust they carried. Once this action was started, slagging would be set up, which the flue-dust would increase. Again, the construction of the arch might have something to do with it. With regard to the question of the difference in the chemical composition of the fuel of refuse destructors, he could only say that it was very hard lines; but it ought to be possible, by frequent tests of the materials and analyses, to ascertain the average composition. Personally, he would prefer the dead dogs to the salted tobacco, as the latter would contain a large proportion of potash salts, whereas the dead dogs' bones would yield phosphates.

ACCIDENTS ON GAS-WORKS.

The following is a summary of the contents of a paper on this subject contributed by Dr. LEYBOLD, of the Hamburg Gas-Works, to a recent number of the "Journal für Gasbeleuchtung."

In every industry there is a certain risk of accidents, and the workmen are exposed to the danger of special accidents which do not occur in ordinary life. Those engaged in the handling, working, and transport of heavy materials, or in attending to complex machinery and furnaces, are exposed to greater risk of accident than is the manual craftsman. On the other hand, the introduction of machinery in place of manual labour has greatly reduced the number of workmen employed in carrying out the same work. Thus, for the work done, the number of accidents is fewer when manual labour is replaced by machinery. The number of accidents reported on gas-works has, on the whole, been continually on the increase; but the increase is explicable by the fact that small accidents, to which no heed would have been formerly paid, are now reported. The number of men employed on gas-works in Germany continues to increase, though not at the same rate as in the past. The increase is chiefly due to small works, because in the large gas-works, notwithstanding an increase in the output, the number of men employed has diminished in consequence of the introduction of machinery, carburetted water-gas plant, and the construction of settings which effect considerable economy in labour. Manual labour, on the other hand, is retained in small and many moderate-sized gas-works. The number of employees on German gas-works in 1909 was 56,731.

Statistics of the number of accidents reported in the gas undertaking of a large town having three large and one small gas-works, in the ten years 1900-1909, are given by the author. The average number of employees was 1581; the number of accidents reported averaged 168 per annum, or 10·6 per cent. on the number of employees; and the number of serious accidents was 10·6 per annum, or 0·7 per cent. on the average number of employees. In compiling such statistics, some difficulty arises as to the figure which should be taken for the number of workmen employed in a year. The lists of the Insurance Association include every workman, even one who may have been employed for only one day. The figures given are compiled from the average number of people employed for the whole year in each section of the works. The detailed figures show that the number of accidents reported, for the most part of a light character, has changed little in the course of the ten years. The number of serious accidents involving the payment of compensation varies from year to year from 0·2 to 1·2 per cent. of the number of employees. These figures include not only the men employed on the works, but also the outside staff, who generally are exposed to smaller risk of accident than the employees on the gas-works itself. If the works staff alone is included, the number of accidents reported during the ten years averaged 14·4 per cent. per annum of the number of employees, and the number of serious accidents averaged 1·1 per cent. per annum. The serious accidents varied between 0·2 and 1·9 per cent. per annum; the latter figure referring to 1909, when there was a serious burning catastrophe.

The figures for the three large gas-works referred to are next stated separately for each of the three works, which are distinguished merely as Nos. 1, 2, and 3. For the No. 1 works, the accidents reported averaged 16·2 per cent., and the serious accidents 1 per cent.; but these average figures are much higher than they would otherwise have been, owing to the catastrophe at the works last year. This disaster was responsible for the percentage of accidents reported that year being 23·2, and the percentage of serious accidents being 2·2. Apart from this increase in the average, due to one day's catastrophe in one year, the average figures for the different works do not differ greatly. The No. 1 works is described as an old works on a restricted area, but partially equipped in recent years with machinery. The No. 2 works is on a spacious site, was systematically constructed, and in recent years has been completely equipped with machinery. Since 1899, also, it has had an installation of carburetted water-gas plant. The No. 3 works is likewise on a spacious site, and when built (in 1903) was equipped with machinery throughout. The systems of retort-setting also vary in the different works. No. 1 at first had producer settings of horizontal retorts set back to back, as well as some direct-fired settings; but recently it has also had installations of vertical retorts and large chambers. The No. 2 works has producer-fired settings with horizontal retorts in benches set face to face. The No. 3 works has settings of inclined retorts. Notwith-

standing these differences in plant, the number of accidents entailing compensation is almost identical in the three works.

The accidents to the different branches of the outside staff are next analyzed. The men engaged on the distributing system and in connecting consumers' services numbered on the average 214 per annum, and the accidents reported averaged 29 per annum, or 13·5 per cent.; while the serious accidents were 0·4 per cent. The public lighting staff reported only 4·2 per cent. of accidents per annum, and only 0·2 per cent. of serious cases. The meter inspectors and repairers had only 0·3 per cent. of accidents reported per annum, and no serious accidents at all. The small number of accidents to the public lighting staff, the men of which clean and attend to the street-lamps, and are exposed to danger from the street traffic, is remarkable. The figures throughout do not include men engaged in constructional work.

Having regard to the fact that the smaller gas-works generally depend on manual labour, and have not the installations of complex machinery which exist on large works, and, moreover, change hands less freely than the latter, so that the proportion of men unaccustomed to the work is smaller, it may be anticipated that the proportion of accidents on the larger will be higher than on the smaller gas-works. The following table shows the number of accidents reported on the gas-works of Germany in the year 1906, arranged according to the size of the works:—

Number of Undertakings.	Size. Number of Men Insured.	Total Number Insured.	Accidents Reported. Total.	Accidents Reported. Per Cent. of Insured Men.	Serious Accidents. Total.	Serious Accidents. Per Cent. of Insured Men.
4	over 1000	9,196	877	9·54	67	0·73
12	500–1000	8,601	705	8·20	55	0·64
74	100– 500	15,715	936	5·96	96	0·62
76	50– 100	5,295	293	5·53	35	0·66
1107	under 50	13,295	523	3·93	65	0·49
1273		52,102	3334	6·40	318	0·61

It will be seen that the proportion of accidents to men insured decreases as the size of the works decreases. [Insurance of all gas-works employees is compulsory in Germany.] It is probable that minor accidents are more consistently and completely reported on the larger gas-works; but it will be seen that the proportion of serious accidents is also lower on small than on large works. It is to be observed that in 1906 there was much more manual labour on gas-works than at the present time; and it will be interesting to trace what effect on the proportion of accidents the further introduction of machinery and of larger types of settings will have. Judging from the figures given for the No. 2 gas-works already referred to, where manual labour has been gradually displaced by machinery, it may be anticipated that the proportion of accidents will remain much as before.

Retort-House Machines at Sheffield.

The Sheffield United Gaslight Company have recently reconstructed, to the designs of Mr. J. W. Morrison, their Chief Engineer, a large retort-house at their Neepsend works. In this house, there has been put to work a hydraulic stoking plant of the Arrol-Foulis charging and the Hunter-Barnett pusher type. The results in some respects are quite exceptional—seeing that the charges in each through retort range as high as 16 to 17 cwt., according to the class of coal used. The time taken to burn off this weight of coal is twelve hours. Notwithstanding these heavy charges, they are well and evenly laid; and no difficulty whatever has been found in discharging the coke with the pusher type of machine. All the arrangements are, we understand, giving entire satisfaction; and the results certainly seem to form another advance in horizontal retort practice.

Scottish Junior Gas Association (Eastern District).—The second quarterly meeting of the Association for the present session will be held in the New Technical College, Dundee, next Saturday. We learn from the Hon. Secretary (Mr. W. Geddes, of Granton) that an address will be delivered by Mr. Alex. Yuill, the Corporation Gas Engineer and Manager; and that a paper on "High-Pressure Distribution" will be read by Mr. James Mitchell, an assistant in the Dundee Gas-Works, which the members will be afforded an opportunity of visiting in the forenoon. At the close of the proceedings, the visitors will be entertained at tea.

Suspended Gas-Mains.—During the construction of a portion of a subway under the Fourth Avenue, Brooklyn, it was necessary, before the steam navvy could begin work, to remove all subsurface structures, such as electric cables, sewers, and gas and water mains. The water-pipe was laid in the position it would ultimately occupy in the pipe gallery. By a special arrangement with the Water Department, the contractor was granted the use of 1400 feet of each size of water-pipe required, and allowed a reasonable percentage for loss and breakage, to facilitate construction; and all pipes crossing Fourth Avenue were disconnected. The gas-mains, which could not be omitted, were raised about 20 feet above the pavement, and suspended by a steel cable across the opening.

FLAME STANDARDS USED IN PHOTOMETRY.

By E. B. Rosa and E. C. Crittenden.

[A Paper presented at the Fourth Annual Convention of the American Illuminating Engineering Society.]

The most successful primary flame standards used in photometry are the Hefner amyl-acetate lamp and the Harcourt ten-candle power pentane lamp. The former is especially favoured in Germany, and is the official standard recognized by the Physikalisch-Technische Reichsanstalt. The latter is preferred in England, and is the official standard of the London Gas Referees and the National Physical Laboratory. Both are used in America, and have been studied and certified at the Bureau of Standards, although neither has been officially adopted by the bureau as the means of fixing the unit of light. In the agreement between the National Laboratories of England, France, and America, whereby a common International Candle is now being maintained by these Institutions, the pentane lamp is stated to have an intensity of ten international candles under standard conditions of atmospheric humidity and barometric pressure, and the Hefner nine-tenths of an international candle, likewise under certain standard conditions of atmospheric humidity and pressure, which are, however, not quite the same as for the pentane lamp. The intercomparisons which preceded and led up to the formal agreement were made by means of incandescent lamp standards, the performance of which was so admirable that they have really been employed as primary standards; and the flame standards themselves, which logically should play the part of primary standards, to which the electric standards should be secondary, have been relegated to the subordinate position.

The use of carefully seasoned incandescent lamps as photometric standards of precision is, of course, not new. Professor Fleming, of London, was one of the first to emphasize their value, and to provide lamps that could safely be used in practice. Two Past-Presidents of this Society, Drs. Sharp and Hyde, have contributed not a little to extending their use and their usefulness. At the Bureau of Standards such lamps have been certified for some years; and recently a very careful study has been made of their preparation and performance. It has been shown that, by operating them at constant watts, their reliability as standards is greatly improved, and that a group of well-selected carbon-filament lamps has a remarkably long useful life as standards when used at 4 watts per candle, and at constant watts. A study is now being made of metal-filament lamps, to see what their possibilities are as standards of whiter colour.

Although electric lamps are very satisfactory as secondary standards, and although as empirical primary standards they may serve to maintain the unit of light constant for many years, yet there is the certainty of an appreciable drift sooner or later if there is no photometric standard, accurately reproducible from its specifications, which is capable of serving as a reliable check upon the electric standards. Another powerful reason for improving flame standards is their extensive use in gas photometry, to which they are better adapted than electric standards if they are sufficiently convenient and reliable. At the suggestion of some representatives of the gas industry—notably Past-President Gartley of this Society, the Bureau of Standards took up the study more than a year ago of some of the more important of flame standards. Of all the photometric standards which have been actually realized, and which are capable of reproduction from their specifications, the amyl-acetate lamp, proposed in 1884 by Hefner von Alteneck, and the ten-candle power pentane lamp, proposed in 1898 by Vernon Harcourt, are the most widely used, and have been the most investigated.

The Hefner Lamp.

The Hefner lamp has had a long and honourable career. Although it has some serious defects—notably its small intensity and reddish colour—and requires much patience and skill and many observations to obtain accurate results, it nevertheless has some important merits. If it had not, it would not now be contesting for first place among primary flame standards, after the world has had a quarter-of-a-century in which to replace it by a better one.

Its principal merits as a primary standard are its simplicity of construction and operation, ease of manipulation, portability, durability, and (when the fuel is right and the lamps are skilfully handled), the excellent agreement of one lamp with another. Its defects are its small intensity, unstable flame, reddish colour, and difficulty of setting the flame at exactly the right height. For either a primary or a secondary standard, these, it must be admitted, are serious objections.

The Reichsanstalt certifies Hefner lamps as correct if within 2 per cent. of their standard. At the Bureau of Standards there are eight Hefner lamps—four made by one company, and four by another—and all fall within this limit. Indeed, the maximum departure of any lamp from the mean of all is scarcely more than 1 per cent. However, a primary photometric standard is not entirely satisfactory so long as appreciable differences exist among a lot of lamps made to the same specifications. Accidental errors will, of course, occur in the measurements; but of these eight Hefner lamps certain ones are regularly high and others regularly low—showing that the lamps are not as nearly identical in construction as they should be. This result is due to two things. In

the first place, the specifications are not precise as they should be; and in the second place, there are in some lamps slight departures from the specifications. That the intensity of the flame may always be the same—under the same atmospheric conditions—it is necessary (1) that the fuel be uniform, (2) that the wick-tube shall always be of the same material and dimensions, and (3) that the height of flame be constant. In comparing lamps, the same fuel and the same kind of wick are used in the different lamps; and comparisons are made with the same apparatus and practically in the same atmosphere, as they are used in succession by the method of substitution. Hence the differences observed are due (1) to differences in flame height, or (2) to differences in effect of the wick-tubes on the size or temperature of the flame.

There are two styles of sight used on Hefner lamps. The earlier form has a horizontal plate, 0·2 mm. thick, in the centre of the sight-tube; and the height of the flame is adjusted until, sighting along this plate, one sees the tip of the flame in the correct position with respect to the plate. In the other form, due to Krüss, the flame is projected by a lens upon a ground-glass screen; and the tip of the flame is made to fall on a line across the centre of this screen. This is the more convenient and preferable form. The eye is fatigued by the naked flame viewed through the first form of sight; and the adjustment cannot be made as accurately to the plate as to the line on the screen in the second form. A slightly higher average candle power is obtained for the lamps having the Krüss sight than for those having the Hefner sight. The authors recommend the use of the Krüss sight only, and for these three separate reasons: (1) It is less fatiguing to the eye; (2) it permits more consistent settings; (3) it makes possible a higher degree of reproducibility by avoiding whatever difference there may be due to using two forms of sight. The flame-gauge is satisfactory, and permits a very close reproducibility in the height of the wick-tube with respect to the sight. When it is remembered that 1 mm. change in flame height represents 2 per cent. change in flame intensity, and hence the allowable error is only a few tenths of a millimetre in the position of the nearly non-luminous tip of the flame, it is seen that this adjustment is one which requires great care and experience, and an optical device for a sight that is accurately reproducible. Unfortunately, this setting at best is not wholly free from the personal equation.

The wick-tube affects the flame in several ways. The bore should be 8 mm. exactly; and this determines to some extent the size of the flame. This dimension is very accurately met in all the lamps. The thickness of the tube is specified to be from 0·14 to 0·17 mm. The wick-tube conducts heat down to the liquid amyl-acetate which saturates the wick, the top of which is from 1 to 3 mm. below the top of the tube. The thicker the tube the more readily is the heat conducted, and the more readily is the amyl-acetate evaporated. Hence, with the thicker tube, the top of the wick must be higher in the tube to keep the flame-height constant. Also, the thicker-walled tube cools the flame more, and therefore reduces its candle power more. Hence, the wick-tube should be very accurately specified to insure reproducibility. A departure of one or two hundredths of a millimetre from the mean in the thickness of the wall of the wick-tube seems negligible; but its effect is not negligible. To insure strict reproducibility, the weight of the tube should be specified, in addition to its bore and length. The composition of the German silver, of which the tube is made, ought also to be specified, to insure uniform results.

The authors are still engaged in their studies of the effects of slight variations in the dimensions of the Hefner lamp, and have reason to believe that if the specifications are drawn closer, and the construction is as exact as it may be, considerable improvement in reproducibility will result. However, the lamp alone is not a standard. The photometric standard is realized only when a certain specified fuel is burned in the lamp in a certain specified atmosphere in a certain specified way. The fuel, amyl-acetate ($C_7H_{14}O_2$), is readily obtained pure enough to satisfy the specifications. The authors have used amyl-acetate bought from a reputable chemical firm, which was guaranteed by them to be pure, which did not conform to the specifications, and which gave a flame of different intensity from amyl-acetate fulfilling the specifications. Hence, the only safe way in precise work is to test the fuel before using it, or purchase only amyl-acetate that has been tested with reference to its use in Hefner lamps.

The atmosphere affects the intensity of the flame very markedly. Oxygen is supplied by the atmospheric air drawn into the flame. With the oxygen go nitrogen, carbon dioxide, and water vapour, which are not needed for combustion, and which cool the flame and reduce its intensity. If the atmospheric air supplied to the flame varies in its composition, the rate of combustion is altered and the cooling effect of the inert gases varies. Hence, it is stipulated that the room in which the lamp is burned must be well ventilated to secure an atmosphere of uniform composition with respect to the proportions of oxygen, nitrogen, and carbon dioxide. The water vapour must be carefully determined, and the barometric pressure recorded and suitable corrections applied. If the ventilation is insufficient, there is an excess of carbon dioxide, and a deficiency of oxygen. A deficiency of oxygen requires a larger amount of air to supply the needed oxygen. Hence, a deficiency of oxygen is equivalent to an excess of nitrogen; and the flame is very sensitive to slight variations of this kind. Fortunately, the humidity can be very accurately measured, using an Assman ventilated hygrometer. Neither an air hygrometer nor an unventilated wet-and-dry bulb hygrometer is satisfactory. The humidity correction has been carefully determined for the Hefner lamp at the Reichsanstalt, and also recently at the Bureau of Standards. The authors' result, based on many determinations, is in close agreement with that of Liebenthal, who first determined at the Reichsanstalt this important correction. The correction is linear, from the lowest to the highest humidities observed, and is about 0·56 per cent. per litre of water vapour per cubic metre of air. It is, therefore, a very important correction, and may amount to from −3 per cent. in dry weather to +10 per cent. in warm, damp weather. The lamps give higher candle-power in dry weather. It is practicable to obtain sufficiently good continuous ventilation to make negligible the error due to variation in the oxygen and carbon dioxide content. The authors prefer continuous ventilation, rather than to depend upon opening the windows occasionally and working between ventilations.

The flame height specified in the Hefner lamp is 40 mm. (1·57 inches), at which height it gives nine-tenths of an international candle. An extended study has been made of the amyl-acetate lamps when burning at a flame height of 45 mm., at which height they give one international candle—at least, those with Krüss sights give on an average one international candle. Taking the mean of all, the height should be about 45·25 mm. It is believed, however, that when the wick-tube is more accurately specified, and the Krüss sights alone are employed, a flame height of 45 mm. will give very accurately one international candle. There is no appreciable temperature light coefficient to the Hefner lamp between the limits of temperature that are commonly employed. It is, however, steadier at from 15° C. to 20° C. than at higher temperatures. Hence for work of the highest precision, a comparatively narrow range of temperature might well be specified.

As a standard for comparison, the authors use a carbon-filament lamp operated at about 9 watts per candle, which gives a colour match with the Hefner. In passing from this colour to that of some other standard, there is, of course, the uncertainty due to the colour difference, over and above the errors due to the comparisons of lamps of different intensities. That is, however, a question which need not be entered upon here.

In Table I. is given a summary of results obtained on eight Hefner lamps, two of which, however, are new lamps and have been compared only a few times. Of the remaining six, three have the Hefner sights and three the Krüss sights. In the first part of the table the results are given for a flame height of 40 mm., and in the second for 45 mm. In the second column is given the number of measurements made on each lamp—a "measurement" being the value found on a given occasion as the mean of twenty or more separate settings on the photometer, and two to five new adjustments of the flame. More than half of the measurements were made by Mr. Crittenden and Mr. Taylor; while the others were made by various persons of less experience with flame standards. For comparison, the results obtained by the more experienced observers are given separately.

The mean value of the first three lamps at 40 mm. flame height (to three decimal places) is 0·896; and of the second three, 0·903—the mean of the six being 0·8995 international candle. This is

TABLE I.—*Summary of Measurements on Eight Hefner Lamps.*

Lamp.	Weight of wick-tube in grammes.	Flame 40 mm. high: All measurements No. of meas.	Flame 40 mm. high: All measurements Mean c.p. int. candles.	Flame 40 mm. high: E. C. C. & A. H. T. No. of meas.	Flame 40 mm. high: E. C. C. & A. H. T. Mean c.p. int. candles.	Flame of 45 mm. high: All measurements No. of meas.	Flame of 45 mm. high: All measurements Mean c.p. int. candles.	Flame of 45 mm. high: E. C. C. & A. H. T. No. of meas.	Flame of 45 mm. high: E. C. C. & A. H. T. Mean c.p. int. candles.	Percentage mean deviation from mean c.p. 40 mm.	Percentage mean deviation from mean c.p. 45 mm.
Hefner sights—											
804 K	1·246	21	0·8897	15	0·8907	17	0·9907	11	0·9925	0·74	0·66
879 S-H	1·145	19	0·8978	13	0·8985	17	0·9919	11	0·9937	0·50	0·65
1342 S-H	1·144	19	0·8961	13	0·8978	17	0·9913	11	0·9887	0 67	0·92
Mean			0 8944		0 8956		0·9910		0·9916	0·64	0·74
Krüss sights—											
786 K	1·311	26	0·9011	19	0·9011	23	0·9578	17	0·9984	0·50	0·65
887 S-H	1·153	32	0·9075	20	0·9068	25	1·0019	18	1·0018	0·44	0·47
1343 S-H	1·121	33	0·9039	21	0·9018	24	1·0001	17	0·9997	0·54	0·70
Mean			0·9039		0·9032		0·9998		0·9998	0·49	0·61
Mean of all			0·8992		0·8994		0·9954		0·9957	0·56	0·68
New lamps—											
1714 K.	1·177	5	0·8908	4	0·8871	—	—	—	—	—	—
1715 K.	1·184	5	0·8968	4	0·8951	—	—	—	—	—	—

The numbers given above for the several lamps are the numbers placed upon them at the Physikalisch-Technische Reichsanstalt, where all were tested and certified. The letters following the numbers indicate the design.

very near, indeed, to the value 0·900 international candle, assigned to the Hefner lamp in the international agreement of 1909.

The mean value of the first three lamps at 45 mm. flame height is 0·992; and of the second group of three, 1·000—the mean of all being 0·996 international candle. This is very near, indeed, to one international candle. As the different lamps vary in candle power on account of slight differences in their dimensions, the agreement between lamps can be improved; and when the closer specifications are drawn, they should be so fixed as to make the candle power at 45 mm. as near as possible to one international candle.

The average difference of the separate measurements from the mean of all, for each lamp, is given in the last columns of the table, for the measurements of the more experienced observers only. They average 0·64 and 0·49 per cent. respectively for the two groups of lamps at 40 mm., or 0·56 per cent. for all. At 45 mm., the average is 0·74 and 0·61 per cent. respectively. That is to say, a single "measurement" is in error on the average a little more than one-half per cent. In the case of lamp No. 1343 at 40 mm., the twenty-one measurements were divided into three groups of seven each. Calling the mean of each group of seven measurements a determination, we find—

	International Candles.		Difference from Mean.
First determination	0·8997	..	0·0021
Second determination. . . .	0·9017	..	0·0001
Third determination	0·9049	..	0·0031
Mean	0·9018	Average	0·0018

Thus, each determination differs from the mean of the three by two parts in a thousand. If the lamp should continue to do as well, and other lamps could be made to agree with it accurately, this would be a very good performance for a primary standard. No reason is known why the lamp should not continue to do as well, nor why different lamps may not be made to agree much better than heretofore. Since the chief differences in the lamps are believed to be due to the wick-tubes, it is mainly a matter of careful construction and painstaking inspection, wherein all tubes not conforming to strict specifications are rejected. Then if each lamp has three or more tubes, all of which are used in succession, and the mean of the results taken, the accidental unavoidable errors in the tubes will be largely eliminated. If the Hefner lamp were to be adopted as a primary photometric standard, it would be advisable to specify further that the mean value of at least three lamps, each supplied with three tubes (at least ten determinations being made with each tube), be taken as the value of the unit.

In the Table I., the lamp in each group that has the lowest candle power has the thickest (and heaviest) wick-tube. Both are from the same maker. Of the remaining lamps, there are two in which the differences in candle power are not explained by the differences in the thickness of the tube. Possibly there is a slight difference in the optical sights. This remains to be investigated.

The results shown above are much better than have been obtained heretofore at the bureau, and illustrate what can be done by experienced observers working under the most favourable conditions. As a working standard under ordinary conditions, much greater errors would, of course, be found.

The authors will continue the studies of the amyl-acetate lamp, and report the results in full detail at a later time.

The Pentane Lamp.

The Harcourt pentane lamp presents a striking contrast to the Hefner. It is bulky, relatively complicated in construction, less portable, and less convenient in manipulation, more expensive in first cost and in fuel, and requires much better ventilation, and a larger photometer room. On the other hand, its higher candle power, steadier flame, and better colour are very great advantages. As to reproducibility, a given pentane lamp is more accurately reproducible than a Hefner lamp, when both are operated under correct conditions; but there is a greater difference among different pentane lamps than among different Hefners.

No wick is used in the pentane lamp. The fuel (pentane, C_5H_{12}) is contained in an elevated reservoir or saturator. Air enters the inlet and mixes with the vapour of pentane as it passes over the liquid pentane through the maze into which the saturator is divided by vertical vanes; and this mixture flows down the supply pipe to the burner. In hot weather the pentane may evaporate so rapidly as to flow out through the inlet, and thus prevent the air from entering. In this case, only pentane vapour is fed to the flame. Air, heated by passing through the annular space between the inner and outer chimney, flows down through the hollow standard, and into the central chamber below the burner. Thus the flame resulting from the combustion of the vapour of pentane as it issues from the ring of thirty holes in the steatite burner is fed with preheated air within the flame, while it takes atmospheric air directly through its outer surface. The height of flame is determined by the distance between the burner and the chimney (which is adjusted to be 47 mm.) and by the rate of supply of the fuel. The latter is regulated by a stop-cock. The tip of the flame is viewed through a mica window in the lower end of the inner chimney, and must be watched and frequently regulated in work of the highest precision. When the flame is right, its candle power is a maximum. As with the Hefner, the intensity of the flame depends upon the dimensions of the lamp, the composition of the fuel, the atmosphere in which it is burned, and the manipulation of the lamp, especially as regards regulating the flame height and screening the flame.

The specifications of the standard pentane lamp were carefully drawn, and have been closely followed by the several makers of the lamps, with, however, some variations in the American lamps. But that the specifications are not sufficiently exact and complete, is shown by the fact that different lamps differ in candle power appreciably. That is, different pentane lamps burning the same fuel, in the same atmosphere, and operated by the same people, differ by as much as 2 or 3 per cent., quite independently of the errors of observation. It is not possible, therefore, to take the light of a pentane lamp as 10 international candles under the stated standard conditions. It may in any particular case be only 9·6 or 9·8 candles at standard humidity and barometric pressure, even when the fuel and all external conditions are right.

The total intensity of the light of the flame depends, of course, on its dimensions; and this is affected by the size of the burner. The specifications say that there shall be thirty holes (from 1·25 to 1·5 mm. in diameter) drilled in a circle in the steatite burner, the outside and inside diameter of which are 24 mm. and 14 mm. respectively. But the precise diameter of the ring of holes is not specified; and this is found to vary in different burners. A stricter specification here is desirable.

It is well known that a pentane lamp increases in candle power for a time after lighting up, and that one should wait from 15 to 30 minutes before taking measurements. The authors know of no careful measurements that have been published to show how or when the light reaches its stationary value. In fig. 1 are given four curves taken during the heating-up period of the lamp, showing that the light increases to a maximum, and then decreases to

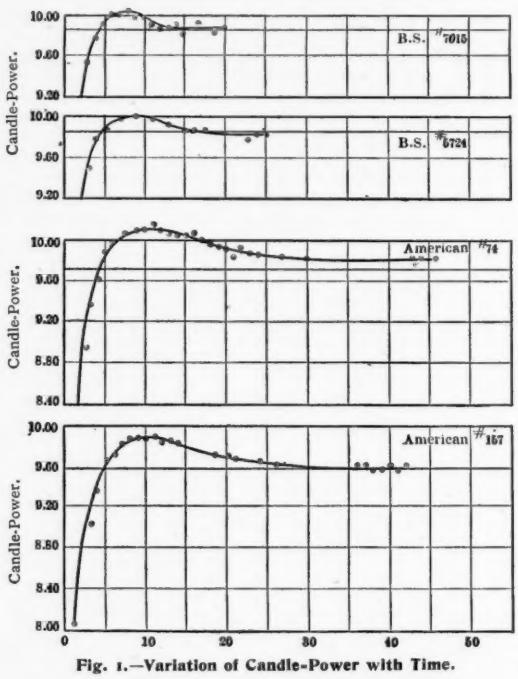


Fig. 1.—Variation of Candle-Power with Time.

its steady value. This maximum is from 1·5 to 3 per cent. above the final value, which is reached in from 15 to 30 minutes. The first two curves are for English lamps, which reach a steady condition in half the time required by the American lamps. The reason for this difference is now being investigated.

The length of the chimney is a very important dimension; and there is little variation among lamps in this particular. The cooling of the flame, due to the conduction of heat, varies with the amount of metal in the lamp and with the details of construction. Possibly the lower candle power of the American-made lamps is due in part to their more massive construction. This is a point in which the specifications might be more explicit. Further experiments on the cause of variations, due to varying details of construction, are in progress at the Bureau; and the hope is to be able to locate the observed differences in the various lamps. Although many lamps, of both English and American make, have been tested, not one has been found that has as high a candle power as the standard pentane lamp of the National Physical Laboratory; 9·9 candles being the highest value found. Their standard lamp seems appreciably above the average; and the English maker of the lamp (from whom the Bureau purchased two lamps) was unable to duplicate it exactly as to candle power.

One of the most difficult features of the use of pentane lamps is the fuel. In addition to the inconvenience of pentane being very volatile and explosive, its composition is variable; and as sometimes supplied it does not conform to specifications. It is distilled from gasoline; its composition being made nearly uniform by repeated distillation. Besides the great difficulty in separating all the butanes (C_4H_{10}) and all the hexanes (C_6H_{14}), pentane itself (C_5H_{12}) exists in three separate forms, which have different boiling

points. Hence, if pentane which complies strictly with the specifications be distilled, it may be separated into three portions of appreciably different boiling points. This fractionation goes on in the saturator, and the photogenic value of the pentane changes to an appreciable extent in two or three hours. The official specifications of the London Gas Referees direct that the residual pentane be emptied out of the saturator at least once in each calendar month. For work of the highest precision, the authors find that it is desirable to do this every time the lamp is refilled, and that this refilling be done very frequently—not waiting until the pentane is nearly exhausted. Mr. M'Bride, of the Bureau of Standards, made a very thorough study of the preparation and testing of pentane, and analyzed the pentane before it was used by the authors. He also tested the amyl-acetate used.

The humidity correction for the pentane lamp, as determined by Mr. C. C. Paterson of the National Physical Laboratory, is larger than that found by Liebenthal, and by the authors, for the Hefner lamp; being 0·66 per cent. per litre of water vapour per cubic metre of air. This determination was published in 1904; and it has been adopted generally as the proper correction coefficient to be used with the pentane lamp. In 1906, Dow derived 0·71 per cent.; but being obtained from a smaller number of measurements, it has been regarded only as a confirmation of Paterson's value. In the earlier works at the Bureau of Standards use was made of Paterson's coefficient in correcting for atmospheric humidity; but it was noticed that the corrected results so obtained gave the lamps a higher value when the humidity was high and a lower value when the humidity was low—that is, the correction for humidity was too great. At first this result was attributed to errors of observation and lack of reproducibility of the pentane lamps; but as the work progressed, and better results were obtained, it became evident that this explanation would not hold. The calculated humidity coefficient from a large number of measurements by the method of least squares gave about 0·57 per cent. instead of 0·66 per cent. Using this lower coefficient, excellent agreement has been obtained in the results in winter and summer, and in damp and dry weather. This coefficient has been separately computed for different lamps, both of English and American make, and all give the same value. Moreover, the same coefficient is obtained using only the low range of humidities (4 to 14 litres per cubic metre), or using only the high range (14 to 27 litres per cubic metre), as when the total range is used. In other words, the humidity coefficient is linear from the *lowest to the highest humidities encountered, and is practically the same for pentane and for the amyl-acetate lamp*. This is a very gratifying result, and puts the pentane and Hefner lamps in a more favourable position as flame standards.

Having become convinced that the smaller humidity coefficient was correct, at least for the conditions encountered by the authors, an attempt was made to ascertain why the value found in England was so much higher. Mr. Paterson's work on the pentane lamp is of a high order; and great confidence was placed in the precision of his measurements. It was recalled, however, that formerly atmospheric humidities had been measured at the National Laboratory (as generally in England) by the ordinary wet-and-dry bulb thermometers, without any artificial ventilation, whereas at the Bureau of Standards use had always been made of the more accurate hygrometer of Assmann, ventilated by a rapid current of air, and which therefore gives a greater depression of the wet bulb, particularly at low humidities. The unventilated hygrometer gives fairly correct results if one uses the tables or formula appropriate to the instrument, although it is less reliable owing to the fact that the air in the room is not always equally still. It appears, however, that the formula used at the National Physical Laboratory was the formula for the ventilated hygrometer; and hence the values of the humidity obtained were too high. The Bureau of Standards some years ago called the attention of the National Physical Laboratory to the fact that, if the standard atmospheric humidity be retained as 10 litres per cubic metre, and the measurements are made by an Assmann hygrometer—as the Bureau of Standards were doing, and as the International Photometric Commission at Zurich in 1907 had recommended should be done generally—the candle power of the pentane lamp under standard conditions would be altered, and if its former value were 10 candles, it would now be smaller. If, however, it were still declared to be 10 candles, the value of the unit would be altered. The Bureau suggested that the change be made in the number expressing the standard atmospheric humidity; so that the value of the unit and the numerical value of the candle power might remain unaltered. This suggestion was adopted, and Dr. Glazebrook announced, in a paper read before the British Association, that the true humidity previously determined as 10 litres by the unventilated instrument was found to be 8 litres; so that the correction formula was

$$\text{Candle power} = 10 + 0{\cdot}066\,(8 - e)$$

where e is the number of litres of water vapour in a cubic metre of dry air. The Gas Referees of London concurring in this proposal, the official value of the pentane lamp has since been expressed by the above equation.

Dr. Glazebrook stated also in this paper that "a complete series of experiments has shown that the constant 0·066 in the formula holds both for the ventilated and unventilated instruments." This means, of course, that the constant is the same when the humidity is computed from observations made on unventilated hygrometers using the formula or tables intended for ventilated hygrometers; the only change in the correction formula being from 10 to 8 in the parenthesis. In other words, the straight line of which the correction formula is the equation has been displaced parallel to itself—its slope remaining unchanged. A little consideration shows this is only true under special conditions.

An unventilated hygrometer in a dry atmosphere shows a lower depression of the wet bulb than does a ventilated hygrometer, because the air about the wet bulb retains some of the moisture taken up by the evaporation, and thus evaporation is retarded; whereas in the Assmann hygrometer the air moves over the bulb so rapidly that it is always surrounded with air of practically the same humidity as that of the room. Hence, the unventilated instrument will show a lower depression than the other. The difference, which is considerable at low humidities, decreases as the humidity increases and disappears at saturation. That is, the depression of the wet bulb is zero in both instruments in saturated air; and hence they will agree as to its humidity.

Suppose, for example, that a pentane lamp is measured in air that contains 8 litres of water vapour per cubic metre at 18° C., and again in air containing 20 litres of water vapour at the same temperature. Suppose its candle power be found to be 10 international candles in the first case, and 9·32 candles in the second. The change of 0·68 candle is due to a change of 12 litres of water vapour per cubic metre; and since the change in candle power is simply proportional to the humidity, it is seen that the coefficient is 0·68 ÷ 12, or 0·057. If, however, an unventilated hygrometer had been employed and an incorrect formula used, so that the first humidity came out 10 instead of 8, the second humidity would have been correctly shown to be full saturation (which the tables show to be 20 litres per cubic metre at 18° C.), then the coefficient found would have been 0·68 ÷ 10, or 0·068. This shows that there must be an error in the coefficient found if measurements at different humidities are made at the same temperature. If the higher humidities are at higher temperatures, as they generally are, the error will be less, and it is possible to choose temperatures and humidities so as to get the same error in the water vapour each time, and thus get a correct humidity coefficient.

In the Weights and Measures Division of the Bureau of Standards, Mr. Pienkowsky has observed readings of an unventilated wet-and-dry bulb hygrometer and an Assmann ventilated hygrometer (both instruments in the same room) for several years past, calculating the humidities from both sets of observations. The approximate expression for the difference between the pressure f_1 of saturated aqueous vapour at the temperature t_1 of the wet bulb and the actual vapour pressure f in the atmosphere is

$$f_1 - f = \mathrm{AB}(t - t_1),$$

where $t - t_1$ is the depression of the temperature of the wet-bulb thermometer, B is the barometric pressure, and A is a constant depending on the instrument, and on the velocity of motion of the air over the wet bulb.

In Jelinek's tables for a mean barometric pressure of 755 mm., the value of the product of AB is taken as follows:

1. For still air	0·906
2. For slightly moving air	0·604
3. For rapidly moving air	0·495

The coefficient given for the Assmann hygrometer is 0·500. Mr. Pienkowsky has computed the humidity from the unventilated instrument, using the constant 0·906, and from the Assmann, using 0·495; and the results have agreed as nearly as could be expected. When, however, the same formula is used for both instruments, the unventilated instrument, which gives lower depressions of the wet bulb by from 0·5° to 3° in actual practice, gives humidity values which are too high by from 1 litre to 4 litres of water vapour per cubic metre of air; the difference depending both on the absolute humidity and the temperature—being less as the humidity is greater, and less as the temperature is lower. It is, however, not the same at the same relative humidity, when both temperature and humidity vary. In order to ascertain what the average difference is between the two methods of obtaining humidity, some of Mr. Pienkowsky's observations have been used to compute the unventilated hygrometer readings by the formula for the other instrument—the differences being plotted against the actual humidities. The mean result is that 10 litres of water vapour per cubic metre of dry air by the unventilated instrument corresponds to 6 litres by the Assmann, under the conditions of temperature under which the observations were taken—namely, a temperature of about 20° C. If the laboratory temperature had been 15° C., the difference would have been about 2 litres. This conclusion has been checked by theoretical calculations from the formula, using the coefficient 0·906 for the unventilated instrument, and 0·495 for the Assmann. The authors hope to obtain from Mr. Paterson the formula employed by him in determining his humidity coefficient, and also to learn the method by which they obtained the difference of 2 litres in the standard humidity.

TABLE II.—*Measurements of Pentane Lamps, April 8 to Sept. 9, 1910.*

Lamp.	Number of Measurements.	Mean C.P. Int. Candles.	Mean Deviation from Mean C.P.
Chance No. 116	220	9·875	0·039
Chance, No. 118	81	9·89	0·028
Sugg, No. 171	165	9·62	0·038
American, No. 25	42	9·61	0·045
American, No. 74	43	9·73	0 038
American, No. 157	46	9·58	0·041
American, No. 162	31	9·80	0·028

In Table II. are given the results of candle power measurements made upon three English and four American pentane lamps. In the second column is given the number of measurements made on each lamp from which the mean value has been computed. As with the Hefner lamp previously discussed, a "measurement" is the mean of a large number (thirty or more) of individual settings on the photometer; the flame being inspected (and adjusted, if necessary) several times during the set. A group of thirty settings (constituting one measurement) on the pentane lamp is made in about 5 minutes, whereas a group of twenty settings on a Hefner lamp requires on an average about 15 minutes. The difference is due to the much greater unsteadiness of the Hefner flame, which often requires waiting for the flame to be steady and at the right height; whereas with the pentane settings are made in rapid succession. The method employed of automatically recording the photometer settings, makes rapid settings practicable in the most precise work. The average deviation of a single instrument from the mean of all is given for each lamp in the fourth column, and amounts to a little less than 0·4 per cent. on the average. It is less in the late work; probably averaging not more than 0·3 per cent.

In Table III. are given the separate measurements in sets of ten, each group constituting a "determination" of candle power, for four pentane lamps. This is to show the order of magnitude of the deviations of each measurement from the mean of a group.

TABLE III.—*Separate Measurements of Candle Power for Two Pentane Lamps.*

American Lamp, No. 25.

9·64	9·67	9·61	9·56
9·59	9·67	9·61	9·62
9·63	9·75	9·62	9·58
9·65	9·70	9·64	9·64
9·53	9·65	9·63	9 64
9·53	9·64	9·56	9·62
9·53	9·63	9·57	9·64
9·46	9·62	9·60	9·56
9·46	9·60	9·65	9·60
9·50	9·57	9·59	9·64
9·552	9·650	9·608	9·610

Mean of all = 9·605.

American Lamp, No. 162.

9·75	9·76	9·87
9·79	9·79	9·87
9 80	9·82	9·78
9·81	9·81	9·75
9·83	9·85	9·73
9·80	9·80	9·77
9·80	9·79	9·79
9·78	9·77	9·80
9·79	9·79	9·83
9·81	9·89	9·78
9·796	9·807	9·797

Mean of all = 9·800.

These variations are due to a considerable number of factors, such as variation in the atmosphere, in the fuel, in the effects of draughts and of flame adjustment, as well as errors of the photometric measurements.

In Table IV., the results are given of different determinations on four American pentane lamps. In the columns headed Δ are the differences from the mean, which average 2·2 parts in 1000 for all the determinations of candle power on the four lamps. The error in the mean would, of course, be less than this if the lamps are as consistent with themselves as they appear to be.

In Table V. are given similar results of a larger number of determinations on three English pentane lamps. The twenty-two determinations on the first Chance lamp represent 220 measurements, or probably about 10,000 separate photometric settings.

TABLE IV.—*Determination of Candle Power for Four American Pentane Lamps.*

Lamp No.	25		74		157		162	
Determination.	Int. Candles.	Δ	Int. Candles.	Δ	Int. Candles.	Δ	Int. Candles.	Δ
1 . .	9·552	−0·053	9·675	−0·052	9·608	+0·032	9·796	−0·004
2 . .	9·650	+0·045	9·754	+0·027	9·591	+0·015	9·807	+0·007
3 . .	9·608	+0·003	9·734	+0·007	9·530	−0·046	9·797	−0·003
4 . .	9·610	+0·005	9·744	+0·017	..	..	..	..
Mean .	9·605	0·026	9·727	0·026	9·576	0·031	9·800	0 005

In the above table, Δ is the difference between a single determination and the mean of the several determinations given in the table. A "determination" is the mean of ten "measurements."

The average value of the deviations of the separate determinations from the mean of all is 2 in 1000 for two lamps, and 1·4 for the third. If the determinations on each lamp be divided up into groups of four, the *mean of each group differs from the mean of all by only one-tenth of one per cent.* This is a gratifying degree of reproducibility. Of course, such results would be obtained only as the means of a considerable number of measurements, even if the flame standards were ideal in their performance, for the errors of the photometric measurements are considerable. That the errors belonging to the flame standards themselves could be so small when measured in all kinds of weather, with a wide range of humidity and temperature, and considerable range of barometric pressure, with many re-settings of the lamps, and over a period of some months, would not have been thought possible a year ago.

But, while the value of a given lamp can be determined with so little uncertainty, the differences between lamps are very considerable. The candle power of the Sugg lamp is 2·6 per cent. less than that of the Chance lamps, whereas two American lamps are slightly smaller in candle power than the Sugg lamp. It is recognized in England that different pentane lamps differ in candle power; so that the standard of the National Physical Laboratory is not that of just *any* pentane lamp, nor *the mean value* of a group of lamps, but a *particular pentane lamp*. It remains to learn how to make different lamps agree as closely as a particular lamp will agree with itself, as was remarked above.

TABLE V.—*Determination of Candle Power for Three English Pentane Lamps.*

Type and Numbers.	Chance, No. 116.		Chance, No. 118.		Sugg, No. 171.	
Determination.	Int. Candles.	Δ	Int Candles.	Δ	Int. Candles.	Δ
1	9·821	−0·054	9·880	−0·011	9·585	−0·031
2	9·827	−0·048	9·876	−0·015	9·587	−0·029
3	9·846	−0·029	9·933	+0·042	9·612	−0·004
4	9·875	0·0	9·889	−0·002	9·579	−0·037
5	9·910	+0·035	9·884	−0·007	9·590	−0·026
6	9·894	+0·019	9·882	−0·009	9·599	−0·017
7	9·880	+0·005	9·902	+0·011	9·644	+0·028
8	9·911	+0·036	9·884	−0·007	9·616	0·0
9	9·870	−0·005	..	..	9·620	+0·004
10	9·903	+0·028	..	..	9·646	+0·030
11	9·895	+0·020	..	..	9·614	−0·002
12	9·907	+0·032	..	..	9·668	+0·052
13	9·872	−0·003	..	..	9·618	+0·002
14	9·883	+0·008	..	..	9·630	+0·014
15	9·847	−0·028	..	..	9·610	−0·006
16	9·854	−0·021	..	..	9·633	+0·017
17	9·871	−0·004	..	..	..	..
18	9·898	+0·023	..	..	..	..
19	9·858	−0·017	..	..	..	..
20	9·876	+0·001	..	..	..	..
21	9·867	−0·008	..	..	..	..
22	9·878	+0·003	..	..	..	..
Mean . .	9·875	0·019	9·891	0·13	9·616	0·019

The determinations of the Chance, No. 116, and of the Sugg lamp recorded above were made between April 8 and Sept. 9, 1910, during which period the amount of water-vapour per cubic metre of dry air varied from 4 litres to 27 litres. The determinations of the Chance, No. 118, were made between July 18 and Sept. 9; the range of water-vapour being approximately from 14 to 27 litres per cubic metre of air.

The various values of the humidity coefficient that have been computed from the measurements are shown in Table VI. Four of the lamps have been used through a wide range of humidity; three only in the higher range of humidity. The same coefficient is obtained for low and high humidity, and also the same substantially for all lamps. The mean value, 0·0567 candle, for a change in the water vapour of one litre per cubic metre, found from 628 measurements on seven different lamps, would seem to be subject to very little uncertainty. The different values obtained in England were discussed above.

TABLE VI.—*Water-Vapour Correction Factor for Pentane Lamps.*

Lamp.	Number of Measurements.	Factor Derived.	Range of Water-Vapour (l. per Cu. M. of Air).
Chance, No. 116 . . .	220	0·0569	4·0–27·0
Chance, No. 118 . . .	81	0·0572	14·1–26·8
Sugg, No. 171	165	0·0561	4·0–27·0
Mean		0·0567	
American, No. 25 . . .	42	0·0577	5·0–14·3
American, No. 74 . . .	43	0·0558	5·0–27·0
American, No. 157 . . .	46	0·0570	18·2–26·8
American, No. 162 . . .	31	0·0562	13·7–26·0
Mean		0·0567	
Mean of all . . .	628	0·0567	

Variation of Candle-Power of Pentane Lamps due to Moisture.

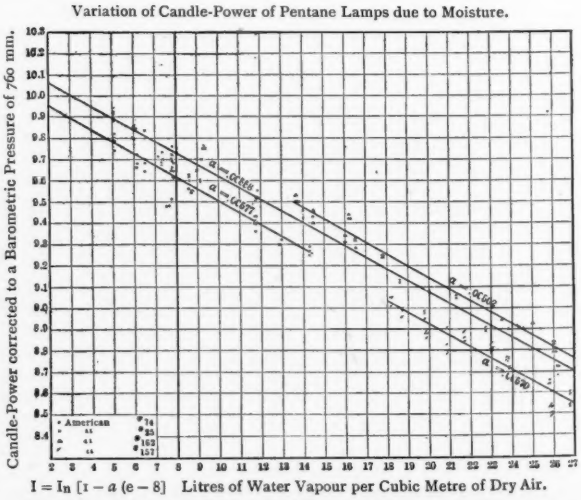

Candle-Power corrected to a Barometric Pressure of 760 mm.
a = 0·0585
a = 0·0567
a = 0·0549
• American
74
85
162
157
I = In [1 − a (e − 8] Litres of Water Vapour per Cubic Metre of Dry Air.

Fig. 2.—Candle-Power of Four American Lamps.

In fig. 2 are plotted the values of candle power, corrected for variation in barometric pressure but not for humidity, for four

American lamps, while fig. 3 shows the results for a Sugg and a Chance lamp.

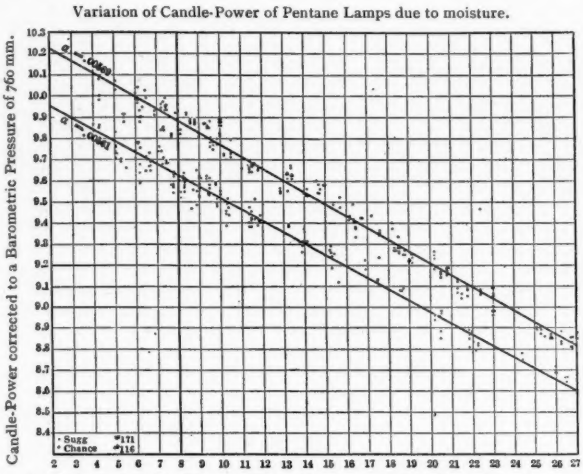

Variation of Candle-Power of Pentane Lamps due to moisture.
Candle-Power corrected to a Barometric Pressure of 760 mm.
I = In [1 − a (e − 8)] Litres of Water Vapour per Cubic Metre of Dry Air = e.
Sugg
Chance

Fig. 3.—Candle-Power of a Sugg Lamp and a Chance Lamp.

The method of determining the humidity is to ascertain, by means of the Assmann ventilated hygrometer, the vapour pressure in millimetres of water vapour in the atmosphere at the time of the measurements. This divided by the barometric pressure *minus* the vapour pressure gives the ratio of the water vapour to the dry air with which it is mixed; and this ratio multiplied by 1000 gives the number of litres of water vapour in 1000 of dry air—that is, in a cubic metre of dry air. This is in accord with English and German practice, and is not quite the same as the number of litres of water vapour (at atmospheric pressure) in a cubic metre of the damp atmosphere.

The authors' value for the variation of candle power with barometric pressure is about 0·6 per cent. for a change of 1 cm. in the pressure. This is not as accurately determined as is the humidity coefficient, because the range of barometric pressures during the period of the measurements has not been very large. The particulars of this determination will be given in a later publication.

Paterson and Liebenthal have made some experiments on the effect on the candle power of adding small quantities of carbon dioxide to the atmosphere. The authors made no measurements on this subject for the reason that the carbon dioxide content of pure atmospheric air is very constant; and if, owing to imperfect ventilation, it has increased enough to affect the candle power, the oxygen will have decreased sensibly, and this will have affected the candle power more than the presence of the excess of carbon dioxide. That is, the candle power will be affected very differently according to whether one litre per cubic metre of carbon dioxide has been added, or so much carbon dioxide has been produced in the air by combustion. It is considered far easier to insure good ventilation, and thereby render correction unnecessary, rather than to try to correct for an excess of carbon dioxide and a deficiency of oxygen.

The formula for the candle power of a pentane lamp, used at present by the authors, is as follows:

$$I = I_n \{1 - 0{\cdot}00567\,(e - 8) + 0{\cdot}0006\,(p - 760)\}$$

where I is the measured candle power, in international candles, of the pentane lamp under the given atmospheric conditions; I_n is the normal value of the lamp—that is, its candle power at an atmospheric humidity of 8 litres of water vapour per cubic metre and a barometric pressure of 760 mm. of mercury; e is the number of litres of water vapour per cubic metre, as described above, found by the Assmann hygrometer; and p is the reading of the barometer in millimetres. Putting a and b for the two correction terms,

$$I = I_n\,(1 - a + b)$$

$$\text{or, } I_n = \frac{I}{1 - a + b}$$

In this paper very few particulars have been given as to the handling of the Hefner and pentane lamps, or the details of the photometric work. The paper is regarded as a preliminary report. In the near future there will be published in fuller detail an account of the work in the "Bulletin of the Bureau of Standards," in which the authors hope to be able to report further than they do now as to the reasons for variations between different Hefner and pentane lamps.

Conclusions.

While much remains to be done on the pentane lamp to make it a thoroughly satisfactory flame standard, the authors feel very much encouraged with the progress thus far, and believe that a much closer agreement between different lamps, and a little higher degree of reproducibility in the same lamp, is possible. For use as a practical flame standard in photometric measurements, and for use as a primary standard for fixing the unit of light, the same lamp should not be employed, and the specifications should be appreciably different. One would not think of employing an ordinary precision meter bar for a primary standard of length, or of using an ordinary precision resistance box for the reference standards of a national standardizing institution. No more should one think of using a pentane lamp that is not too good for a gas-works or for ordinary photometric practice as a primary standard for fixing and maintaining the unit of light. There should be as much difference here as in other physical standards. Mr. Vernon Harcourt has rendered a great service to photometry and to the industries in developing his various pentane lamps; and the authors cannot refrain from expressing their admiration for the thoroughness with which he worked in the pioneer days of precision photometry. But with the increased demand for accuracy of measurement, further improvement is necessary, not only in the construction of the lamp, but in its use as well. Instead of using the usual style of lamp, at any temperature and any humidity, with the pentane that satisfies ordinary requirements, there should be a lamp (or several lamps) built as precision instruments to very exact specifications, operated within very narrow limits of temperature and humidity, with pentane satisfying much more rigorous requirements as to density and boiling point, and an atmosphere maintained constant as to oxygen content with great care. With such painstaking procedure the unit of light can be fixed with either the Hefner or the pentane lamp with very considerable precision—sufficient to serve as a valuable check on the admirable electric standards now in use. It is with a view of contributing something to the working out of such precise specifications that the work of investigation at the Bureau of Standards will be continued.

PNEUMATIC JOINTING OF LARGE GAS-MAINS WITH LEAD-WOOL.

By Colin C. Simpson, Jun., of the Consolidated Gas Company, of New York.

[Extracts from a Paper written for the Fifth Annual Meeting of the American Gas Institute.]

The first attempt at pneumatic caulking was made by this Company in the Summer of 1900 on a 30-inch main; the joints being the regulation cast-lead and yarn with the depth of lead about 3½ inches. The experiment did not succeed for two chief reasons. The first of these was the impossibility of caulking the lead back for more than ½ inch or ¾ inch from the face of the hub; the balance of the joint remaining in the same condition as when first poured. The more the pressure applied, the tighter was the ring driven, until finally the hub split. The second reason for failure was the inability to reduce the amount of time taken to caulk the joint. Given the same amount of caulking time for both hand and compressed air joints, the cost of the latter would naturally be higher, on account of the operation and depreciation charges on the plant in use.

With the advent of lead-wool, and its adoption by this Company to the exclusion of cast-lead, the question of pneumatic caulking again came to the front. While lead-wool joints are more efficient than those made with cast-lead, there are two factors which make them more expensive. The first of these factors—the cost of the raw material—we are, unfortunately, unable to control. The second factor is the length of time necessary to caulk the joint. When we consider that it takes two experienced caulkers ten hours to yarn and caulk one 48-inch lead-wool joint, it is evident that the labour cost is a rather large item. Anything which will reduce the caulking time without a corresponding increase in labour will result in a material reduction in the cost per joint.

With this end in view, it was decided early this Spring [1910] to make a series of tests on pneumatic caulking, with the idea of introducing it on the large mains to be laid during the Summer. At the time, there was in process at one of our yards a school of instruction for lead-wool caulkers; and by carrying on our tests at this time and place, we were able to secure a very fair comparison between the hand and air work.

For this hand-caulking instruction, a number of specially prepared 30, 36, and 48 inch joints had been set up. These consisted of very short split hub sections held firmly together by wrought-iron bands, with spigot pieces 4 or 5 feet long inserted in the hubs; the whole joint being firmly held in place by posts and braces. These joints were yarned and caulked; a record of the time was kept for each operation; and on completion, the removal of the split hub made it possible to inspect and weigh the lead-wool contained in the finished joint. This weight was compared with the average weights of cast-lead and lead-wool usually contained in a joint of the size in question. In addition to this, a random section of the lead-wool was cut out with a hack-saw, and its specific gravity obtained, to determine how nearly the lead-wool had been compacted to the density of cast-lead.

Lead-wool is caulked in the following manner: The material comes from the manufacturer in strands about ½ inch in diameter, and from 2 to 3 feet long; each strand being twisted up to about the shape of an old-fashioned cruller. These are straightened out and re-rolled until we have a fairly hard strand, not quite as thick as it was originally, with a slight taper at each end. These strands are caulked into the joint separately—taking care, of course, that the breaks do not come directly over one another; and when the

face of the hub is reached, the joint is finished off in the same manner as with cast-lead.

The first joint attempted was a 48-inch, which had been previously yarned by hand. We used a small gasoline driven compressor of about 50 cubic feet capacity. No attempt at speed was made on this joint, as it was necessary to instruct several "green" caulkers in the handling of the hammers, and also to do some experimenting in order to produce a proper caulking tool. The hammer used was an Ingersoll Rand "Imperial" chipping-hammer, with a 3-inch stroke. The tool which we finally found to give the best results was forged from a $\frac{7}{8}$-inch hexagonal steel tool-blank, and was similar in shape to that shown.

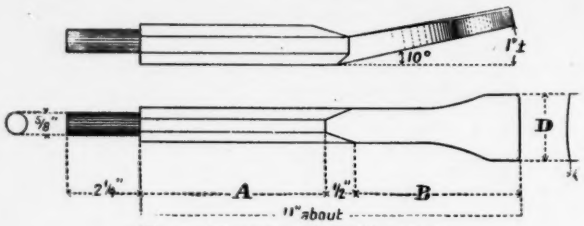


Fig. 1.—Dimensions of Caulking Tool.

Size of Pipe.	30-Inch.				36-Inch.				48-Inch.			
	A	B	C	D	A	B	C	D	A	B	C	D
Yarning iron . .	6½	4⅜	3/8	1⅞	4	6	3/8	2¼	3½	7	3/8	2
Caulking tool No. 1	6½	4⅜	3/8	1⅞	4	5½	½	2	4½	6	½	2
Caulking tool No. 2	..	..	..	..	4	5	5/16	2	5½	5	½	2
Caulking tool No. 3	..	..	..	..	..	..	..	..	6½	4	3/8	2
Finishing tool . .	6½	4⅜	⅜	1⅞	4	4½	⅜	2	6½	4	1	2

On the completion of this 48-inch joint, the split hub was removed for inspection. The lead-wool was found to be very well compacted; the few irregularities being due, no doubt, to the caulker's failure to put enough of his weight against the tool. The yarn had been driven back about ¼-inch, and was hard enough to have made in itself a gas-tight joint. The weight of the lead-wool was a few pounds lighter than the average; but taking into consideration the fact that this was the first attempt, and that the caulkers were absolutely unfamiliar with their tools, the result was more than encouraging.

As it was necessary to come to a decision in a very few days whether or not we should adopt pneumatic caulking, it was decided to make the balance of the tests on a 30-inch pipe; this being an average size, and taking very much less time to caulk than did the 48-inch one.

A 30-inch joint was, therefore, yarned up; and the Ingersoll Rand Company's representative volunteered to caulk this against time. The joint was completely caulked by this one man in an hour, as against 5½ hours, the average time for hand work. An inspection of this joint showed it to be quite as well compacted, and to weigh several pounds more than hand-caulked joints of this size.

An Italian caulker, who had handled air-hammers before, was then placed on this joint, and supplied with a helper to roll and place the lead-wool—enabling him to caulk continuously. Francisco kept at it pretty steadily, and finished his joint in 45 minutes. On inspection, it proved to be quite as good as the first, with the exception of being about 4 lbs. lighter. No attempt was made at pneumatic yarning, as we had, at the time, no tool-blanks of sufficient length to forge out a set of yarning-irons. We decided, however, to try this out during the summer's work; and I might add here that it has been more than successful. The information obtained by these tests was then placed before the head of the Department of Mains and Services. He decided that the scheme was worthy of an extensive trial under working conditions, and authorized the purchase of two portable compressors, with sufficient tools and equipment for each to work a gang of six or eight caulkers.

There were a dozen or more makes of portable compressor outfits on the market, any one of which would probably have answered our purpose, though, unfortunately, no one of them had been used before on this sort of work. The ideal outfit to meet the working conditions should embody the following main features:—

Light Weight, so as to be easily moved from one place to another without the aid of horses.

Self-Contained Water-Cooling System. The cost of a hydrant connection in New York City is about $4 per day.

Simple Gasoline Engine. Gasoline is cheap and easily obtained, and most gasoline engines may also be run with gas. Steam is too expensive for an outfit of this size; and as both direct and alternating currents are used in different parts of New York City, two sets of motors would be necessary if an electric drive were adopted.

Air Capacity of 50 to 75 Cubic Feet. This will take care of seven or eight hammers—the maximum necessary to use under average working conditions.

Moderate Cost. The more expensive the outfit, the greater the depreciation charge, which, in turn, naturally affects the cost per joint.

After giving a tabulated statement showing the cost, air capacity, &c., of the different outfits investigated, the author proceeds: The hammer adopted was the Ingersoll Rand "Crown" chipping-hammer, having a piston stroke of 3 inches. With a gang of eight caulkers working, it is necessary to have ten of these tools. Then if a caulker has any difficulty with his hammer, he is given one of the spare tools, and the trouble (usually nothing serious) can be remedied by either the foreman caulker or the compressor engineer.

We had some little trouble at first with the hammers—due, no doubt, to the lack of experience on the part of the men handling them. The barrels became loose after working for an hour or so, allowing some of the air to escape; and several of the handle bolts snapped off. We were unable to find the reason for this ourselves and complained to the manufacturer. An expert was sent up on the work from the factory to investigate, and reported as follows:—

I found four hammers at work on the job, all with loose handles, which, from watching the operators, I am satisfied was caused by failure of the men to hold the hammers up hard against the tool while working. This caused the piston to strike the front end of the hammer, which resulted in the shock being transferred to the thread on the cylinder and handle, thus causing an expansion of the handle.

Relative to the breakage of bolts, I removed the bolts that were in the hammer, and replaced them with nickel-steel bolts; and by placing the lock-washer under the head of the bolt, instead of under the nut, I found that it gave the desired results—*i.e.*, a tight handle—as after watching the tools for three hours longer in actual service, I found that none of the handles came loose.

The split handle complained of was the result of the same cause, inasmuch as the constant jarring had split the handle, and the constant tightening of the bolt under the split handle caused it to spread.

Very little difficulty of this kind has since been experienced with the hammers. Their work has been quite satisfactory, and the troubles we do have can generally be traced back to a green or inexperienced caulker. The yarning and caulking sets were forged by our own blacksmith from a special 1-inch octagonal steel tool-blank, 11 inches long. Fig. 1 shows the shape and dimensions of the tools used on the different sizes of pipe. These tools are the product of quite some experimenting with different shapes and sizes, and give excellent results. As different joints of any size of pipe vary considerably in width, it is necessary to have several caulking sets, with different thicknesses of face, to meet these conditions. The broad-faced finishing tool is only used in facing-off the last strand of lead-wool.

Fig. 2.—Pneumatic Caulkers at Work.

Where it was possible to place the compressor alongside the trench near the joints to be caulked, the tool-hoses were all run from a manifold tee, which was, in turn, connected to the air receiver by a 3-inch rubber hose. This plan is much more satisfactory than that of running a long wrought-iron pipe-line; the friction and air leakage losses being reduced to a minimum. Of course, there were cases where it was impossible for the compressor to stand alongside the trench, and the wrought-iron line consequently had to be run.

The first gang of compressed air caulkers was started on a 48-inch line. The men were allowed to go along slowly at first, until

they became accustomed to the work; and no cost figures were kept for two or three weeks. A certain amount of trouble was anticipated at the start, as men of this class are naturally opposed to anything tending to reduce hand labour, and will try in their own quiet way to do what they can to "beat the game." And they did for a short time.

As first organized, the gang consisted of nine caulkers, eight of them working in pairs and one acting as foreman—his duties being to assign the men to their joints, and to inspect the finished work. There were also two labourers rolling the lead-wool for the caulkers, and a compressor engineer. After several weeks' work with this organization, a cost report (given in detail below) was turned in. This report covered the last three days only of the third week's work.

Number of joints yarned and caulked	19*
Caulkers, at 30 c. per hour	$90·00
Labourers, rolling lead-wool at 19 c. per hour	11·40
Compressor engineer at 30 c. per hour	9·00
Total labour cost	$110·40
Gasoline, 29 gallons at 11 c.	3·19
Lubricating oil, ½ gallon at 50 c.	0·25
Repairs and renewals	—
Total cost	$113·84
Cost per joint	5·99

Average time taken to yarn and caulk joint, 6 hours.

* All yarning done by hand.

To this figure must be added a depreciation charge on the plant in use, of about 30 c. per joint. This is, of course, a very hard figure to determine absolutely. If we take the cost of the plant complete as $1900, and figure that it will last for six years, and average 1000 joints per year, the depreciation cost per joint will be as stated above. Adding this 30 c. gives us a total cost per joint of $6·29. To complete 19 joints in three days, by hand, would mean a gang of twelve caulkers and a foreman, with some overtime. The cost per joint would figure as follows.

380 hours caulkers, at 30 c.	$114·00
60 hours labourers rolling lead-wool, at 19 c.	11·40
32 hours foreman, at 30 c.	9·60
Total cost	$135·00
Cost per joint (hand)	7·11
Cost per joint (air)	6·29
Saving air over hand, per joint	$0·82

While there was an actual saving of 82 c. per joint, it was nothing like the result we had expected; and it was decided to observe the work more carefully, and see whether it was not possible to cut the cost still further. A little personal investigation developed the following points.

The foreman, being a caulker himself and naturally in sympathy with his men and their desire to "beat the game," was making no attempt to push the work, and had finally established a rule that one hammer to each pair of caulkers was all that was necessary. Consequently, one man remained idle while the other caulked his side of the joint. The men rolling lead-wool worked fast enough only to keep the caulkers supplied, and stopped whenever there was no caulking going on. As a matter of fact, one able-bodied boy could have rolled in a day enough lead-wool to keep the gang supplied for a week. Then the yarning was being done by hand; making the cost of yarning a joint actually greater than that of caulking it.

It was quite apparent that the whole proposition was one of system. Pneumatic caulking is much quicker and easier than hand work. Keep the caulkers busy all the time, with their work laid out intelligently in advance, have the tools, yarn, and lead always at hand (so that it is unnecessary for a man to leave the trench), and the result will be a considerable saving both in money and time.

As a result of this investigation, the force was reorganized according to the following scheme. A foreman who was not "one of the gang" was placed in entire charge of the caulking, and given to understand that his job depended on his ability to push the men and reduce the time per joint. He was furnished with blank reports, and instructed to forward one properly filled out each night to the main office. This report served two purposes—it allowed the work to be followed very closely by the interested parties at head-quarters, and it also caused the men themselves to brace up, knowing their individual results were watched. We were also able to keep better informed about the compressors and tools, and to compare the results obtained with different types.

It was decided at this time to yarn all joints by air. This proved quite successful; the yarning time being cut from 2 hours 15 min. to as low as 30 min. The lead-rolling force was cut to one man, who was sent away from the work to the storeroom and kept busy, whether the caulkers were working or not. Still another improvement was made by providing the gang with a labourer acting as a tool-man. Quite a lot of time had formerly been wasted by the men in running around looking for tools. The average Irish caulker when looking for anything (with the possible exception of a fight) has about as hard a time finding it as our well-known friend Diogenes. When tools were needed, it was up to the tool-man to provide them—enough spare hammers being kept in reserve to immediately replace any needing repairs or adjustment. The caulkers were not under any circumstances allowed to leave the trench during working hours. With these changes, the gang made a fresh start; and the results shown by the next cost report were more than gratifying.

The conditions under which the work covered by the report was done were unusually severe. The joints were all in a loose rock trench, running through very low ground; the presence of salt water making it impossible to caulk at high tide. The cost per joint would naturally be higher under these conditions, as a certain amount of time is lost in shifting the whole gang to another part of the work when driven out by the water. The greater speed possible with pneumatic caulking was especially valuable to us here, as we were able to complete a whole joint between tides instead of having to leave it when partly completed, and then come back the next day and clean out the mud before being able to continue.

The following is an abstract from the cost report.

Total number of joints yarned and caulked, 39	
All labour charges (caulkers, foreman, tool-man, lead-man, and compressor engineer)	$189·46
Gasoline, oil, and repairs.	5·44
Total cost, 39 joints	$194·90
Cost per joint	$5·00
Plus depreciation on plant—per joint	0·30
Total cost per joint	$5·30

This cost would undoubtedly have been lower still, but for the fact that half our hammers had been sent to be fitted with lock-nuts and washers, as recommended by the expert.

It would not be quite fair to compare this cost per joint with the cost of hand caulking in a dry trench. If it requires ten hours for two men to yarn and caulk a 48-inch joint under normal conditions, it would certainly take twelve hours to do the same amount of work in a tide-water trench. On this basis, the cost per joint would have been as follows.

Two caulkers, 12 hours each, at 30 c. per hour	$7·20
Labour rolling lead (per joint)	0·30
Foreman caulker (per joint)	0·40
Total cost per joint—hand caulking	$7·90

There was, therefore, a saving of $2·60 per joint, or about 33 per cent. The daily cost reports to date on this particular line have checked this figure very closely—the saving of air over hand work averaging about 30 per cent.

On the line in question, there were roughly 750 joints. Taking the average cost per hand-caulked joint as $7·11, the total cost of hand caulking would have been $5332·50. The total saving, using air tools, would, therefore, be very close to $1600; so that the outfit will practically pay for itself in the first season's work.

These figures are quite conservative. While the weather conditions were ideal, there was quite a little time lost in shifting the compressor around, as the pipe was being laid at two different points on the line, and it was never possible to have a straight run to caulk off more than 300 feet. There were also days when there was no pipe ready for caulking. When this condition arose, the foreman and compressor engineer overhauled and cleaned the compressor and the air hammers, and the caulkers were put to work as labourers.

The ability to caulk several joints quickly proved of great value on this line, in allowing some rather bad street intersections to be finished up and back-filled with the least possible delay. While the money value of such a saving would be rather hard to compute, it must be quite an item when we consider the maintenance of intersecting pipes and sewers, sheeting, shoring, temporary bridges, night and day watchmen, and the ever-present possibility of accidents to vehicles and pedestrians with the street open.

We were quite pleased to find that we were able to get from 10 to 15 per cent. more lead-wool into these joints by means of the pneumatic tools than we had previously been able to get by hand. This proved conclusively that pneumatic caulking gives a more compact, and consequently a more nearly gas-tight, joint than the old method.

The second compressor to arrive was placed on a 36-inch line, and, after spending some time breaking-in the caulkers, a gang was organized along the ideas described above. The same difficulties were experienced at first. A few tools were broken, and the compressor stopped unexpectedly a few times; but finally things were licked into shape, and we began to get results. The compressor on this line was larger than that on the 48-inch one, and it gave excellent service drilling rock, at the same time running enough hammers to keep all the caulkers busy. At the time of writing, there has been more rock drilling on this line than caulking; so there is still room for improvement in the cost figures. This will, undoubtedly, come with practice and systematization of the work.

Taking an average daily report from this line, the cost per joint figures as follows:—

* Total labour and compressor cost	$17·75
Number of joints yarned and caulked	9½
Cost per joint	$1·85
Plus depreciation on outfit, per joint	0·30
Total cost per joint	$2·15

Also 41 feet of 1-inch hole drilled at a cost of 21 c. per foot.

* On this work we were able to obtain caulkers at an average of $2·50 per day, as against $3 on the 48-inch line.

The cost of hand-caulking per joint would have been as follows: To do nine 36-inch joints in a day would take a gang of ten hand-caulkers at an average rate of $2·75 per day. A pair of good hand-caulkers can do two joints in a ten-hours day; but the average will be a little less than this. No time for a foreman caulker is charged, as the pipe-foreman on this line looks after the caulking; and for a given number of joints his time would be the same for both compressed air and hand work.

Ten caulkers, at $2·75	$27·50
Labour rolling lead	1·00
Total cost, nine joints	$28·50
Cost per joint	$3·17

This gives a saving per joint in favour of compressed-air caulking of $1·02, or about 32 per cent.—very close to the average percentage of saving on the 48-inch work.

It will undoubtedly be possible to cut the cost per joint on the air work still further when it is not necessary to drill rock and caulk at the same time. The drills use a large amount of air, and make it impossible to run more than six caulking hammers. The compressor can easily run double this number, and the fixed charge per joint (which is a fair-sized item) could, therefore, be cut in half.

The caulkers will also in time become much more expert—thus increasing the number of joints per day. The working conditions on this line were not as severe as on the 48-inch pipe previously described; but when we stop to consider that more than half the caulkers were absolutely green (not even having a hand-caulker's experience), the results are very encouraging. Caulkers are not always numerous in New York City; and if it is possible to break-in absolutely green men as quickly and satisfactorily as this, our troubles are ended in this direction.

The compressor outfit proved quite satisfactory. A $2 per day labourer, who had never before seen a gasoline engine, was able to run it without any trouble; and the repairs cost next to nothing. The only possible objection to this outfit was the inability to move it readily, on account of its weight. We expect to purchase a smaller outfit of this type, of half the air capacity and about one-third of the weight, to be used for caulking. The larger compressor will then be used exclusively for rock-drilling, where it is not necessary to make as many shifts.

It might be well to add here that a compressor need not be looked upon as a dead loss during the Winter months, or when no outside work is in progress. There are many ways in which compressor air tools can be used to advantage on repair jobs around the works; and the testing of long stretches of main becomes an easy matter with a ready supply of air at any required pressure always at hand.

We were so well pleased with the results on the 48-inch and 36-inch lines that a third compressor outfit was ordered for use on the 30-inch work. This compressor, unfortunately, we were only able to use for two weeks when the work was temporarily suspended on account of a delayed shipment of pipes. The results obtained in these two weeks were, however, quite promising; and with very little practice a pair of caulkers would be able to do five joints per day, as against two by hand. This would give a saving of about 30 per cent., and possibly better, as the working conditions here are ideal. The caulking gang was organized on the same basis as that described for the 48-inch line; and past experience enabled us to eliminate most of the troublesome features.

The average air pressure carried on the receiver gauge was about 70 lbs. This gave from 50 to 65 lbs. pressure at the tool and was found quite sufficient. The compressors were all fitted with unloaders, which, when set for any given pressure, regulated the air supply automatically.

From the results obtained on these three lines, it would certainly seem that pneumatic caulking of lead-wool joints gives better and quicker work with a considerable saving in cost. The caulkers themselves are better satisfied, as their work is much easier; and it takes considerably less time to break in a man as a pneumatic caulker than it does to get him in shape to swing a 3½ lb. hammer for ten hours.

INDUSTRIAL PYROMETRY.

Mr. Charles Darling's Cantor Lectures at the Society of Arts.

In previous issues of the "JOURNAL," brief reference has been made to the course of Cantor Lectures on the subject of "Industrial Pyrometry" recently delivered before the Royal Society of Arts by Mr. Charles Darling. The lectures are now being published in the Society's "Journal"—the first having appeared in the number for the 23rd ult.; and to it we are indebted for the following particulars.

The lecturer commenced with a brief survey of the history of pyrometry; this being considered by him a fitting preface to the study of modern pyrometers. The first attempt to record the thermal condition of a fire in terms of degrees on a thermometric scale was made by Sir Isaac Newton in 1701. A bar of iron was heated in the fire, and then removed and allowed to cool under uniform conditions. Small pieces of tin and other substances, the melting-points of which had been previously determined, were placed upon the bar, and the time taken by it to cool down from a red heat to the melting-point of tin was noted, and also the time which elapsed between the congealing of the tin and the substances of lower melting-points. Sir Isaac found that the heat of a small coal fire was 465° C., or 1050° Fahr., and for a fire in which wood was burnt 620° C., or 1148° Fahr. To Newton, therefore, is due the credit of first extending the thermometric scale into the region of visible heat. It was not until 1782, however, that a practical instrument for measuring the thermal condition of a furnace, with a view to proper control, was invented. This was done by Josiah Wedgwood, the famous potter, who introduced a pyrometer based on the permanent contraction undergone by clay when fired, by the aid of which he was able to control the temperature of his furnaces more closely than had previously been possible. He made an attempt to express the arbitrary degrees on his scale in terms of the accepted Fahrenheit degrees, and concluded that each degree was equal to 130° Fahr. He assigned to the melting-point of silver the value of 4717° Fahr., and to molten cast iron 17,977° Fahr. The accuracy of these figures was first of all challenged by Daniell, who in 1822 obtained 2233° Fahr. and 3479° Fahr. respectively for the two metals.

In the above-named year, Seebeck discovered that if a junction of two different metals forming part of a closed electric circuit be heated, a current of electricity is produced in the circuit. On placing the junction in a flame, a spot of white light, reflected by a mirror on to a scale, moved along; the distance increasing with the heat of the junction. Becquerel proposed in 1826 to apply this phenomenon to the measurement of high temperatures; but he was unable to obtain concordant results. This experience was shared by others, who afterwards worked in the same direction. Pyrometers based on the expansion of a gas were first suggested by Prinsep in 1828; the calorimetric method was patented by Byström in 1862; the optical method was first applied by Edouard Becquerel in 1863; and the resistance method originated with Sir William Siemens in 1871. All these methods are employed at the present time.

Prior to 1886, pyrometers were little employed in the industries, mainly for the reason that a sufficient degree of accuracy had not been attained in their indications to impress upon manufacturers the advantages to be derived from using them. The perfecting of the thermo-electric method by Le Chatelier in the above-named year furnished a means of regulating high temperatures with great precision, the advantages of which were quickly recognized. In the manufacture of steel, the difference of a few degrees, which would escape detection by the most skilful eye, is of vital importance in determining the character of the finished product. An exact instrument is therefore of great service; and Le Chatelier's pyrometer soon came into practical use. By its aid tests could be carried out at various temperatures which could be reproduced with certainty, and new methods of heat treatment were thus discovered. Other industries were not slow to recognize the value of precise temperature control; and every year since 1886 has seen the continued extension of the use of pyrometers. Various new instruments have been invented and found a successful application, until at the present time the manufacture of pyrometers has become an important industry in itself.

The lecturer passed on to describe the pyrometers now in use; commencing with those of the calorimetric or water type. He showed the earliest instrument of this kind, as made by Byström, and in use in the Royal Arsenal, Woolwich, in 1863; also a later form, sold by Messrs. Siemens Bros. and Co. The advantages possessed by this instrument are, it was stated, low first cost and simplicity in use. A great drawback, however, is that a special experiment has to be conducted whenever it is desired to know the temperature of a furnace. The closest approach to accuracy which may be expected under working conditions is represented by nearly 20° C., or 40°. Fahr. Hence the water pyrometer cannot be applied in cases where an error to this extent is of importance. A simple method for obtaining casual readings of the temperature of a furnace is to insert a number of substances of progressive melting-points, and to observe which of them survive. This is called the "fusion" method; and its most accurate development is due to Herr Seger, of Berlin, who has produced clays of varying composition with melting-points ranging from 590° C. (1094° Fahr.) to 1890° C. (3434° Fahr.)—no interval being greater than 30° C. (86° Fahr.). For greater convenience in observation, the clays are shaped into triangular pyramids and numbered; and several of them, possessing melting-points judged to approximate to the temperature of the furnace, are inserted. The one which bends over shows the temperature, as ascertained from a table that records the melting-point with reference to the number.

In conclusion, the lecturer said high temperatures might be approximately ascertained by measuring the expansion of an iron bar encased in a fire-clay tube or of graphite in an iron tube, or by enclosing mercury in a steel tube to which a pressure-gauge is connected—pressures being translated into corresponding temperatures by comparison with an accurate pyrometer. Both methods were, he said, in use, but were not of sufficient importance to call for detailed description. In his next lecture, he would describe pyrometers which have been successfully employed for work of precision in various industries.

In addition to the water pyrometer of Messrs. Siemens Bros. already referred to, the lecturer showed a plumbago expansion pyrometer and a mercury-pressure pyrometer.

USE OF HIGH-PRESSURE GAS FOR INDUSTRIAL PURPOSES.

An article by Herr F. Messinger, Gas Inspector of Charlottenburg, in a recent number of the "Journal für Gasbeleuchtung" describes the equipment of installations of high-pressure gas for use in industrial heating, and refers to a number of the more important industrial applications of such gas. A few particulars may be given from the article.

The author does not deal with high-pressure gas for lighting purposes, nor with the supply through high-pressure street-mains. He refers to independent compressing plant for the supply of factories and even small workshops. The gas drawn from the ordinary low-pressure supply mains is compressed by means of a rotary blower, which in the case of small workshops may, for economy of ground space, be mounted on a wall bracket. The blower may be driven from any power shaft in the factory, or by a gas-engine or electro-motor. The power required is about 1 H.P. per 1000 cubic feet of gas compressed per hour. The arrangement of the blower and connections is shown in fig. 1, in which S is a safety relief valve on the low-pressure gas supply; V^1 is a high-pressure valve on the low-pressure gas supply; V^2, a high-pressure valve on the bye-pass connection between the high and low pressure services; V^3, a high-pressure valve on the

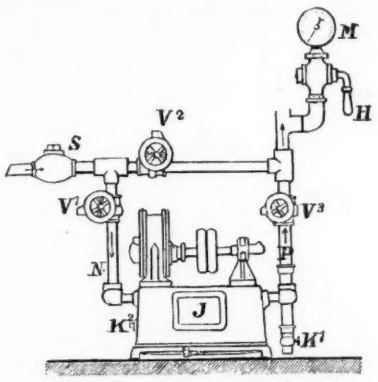
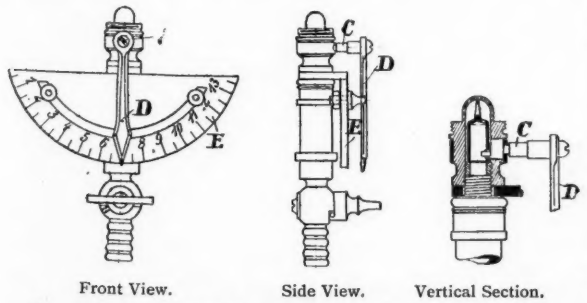


Fig. 1.—Compressor and Connections.

high-pressure supply; K^1 and K^2, outlets for condensed liquid; M, a high-pressure gas-gauge; H, a cock on the connection to the gauge; J, an inspection lid to the chambers of the compressor. It will be seen that surplus compressed gas is returned through a bye-pass to the low-pressure side of the compressor. Any desired pressure may be secured by weighting the valve. Automatic lubrication is provided. A special high-pressure valve is used at the outlet of the compressor; but the remaining taps are of the ordinary full-way type, though of sound and heavy construction. They must be capable of withstanding a pressure of 4 inches of mercury without any leakage. A reciprocating piston-pump may be used for compressing the gas; but this occupies more space, is more complicated, and gives a less regular pressure than a rotary blower.

The ordinary gas service pipes will serve for high-pressure gas provided they withstand the test of 4 inches of mercury pressure. The author points out that it is a mistake to control the flow of high-pressure gas to the burner by a gas-tap in the ordinary way, because there is a certain intervening space between the tap and the nozzle or nipple through which the gas issues. If the flow of gas is checked at the tap, the pressure between the tap and the nipple is reduced, and the high-pressure gas then becomes in effect



Front View. Side View. Vertical Section.

Fig. 2.—Precision Regulating Nipple, with Index-Hand and Scale.

low-pressure gas. Care must be taken that the high pressure is maintained right up to the nipple. Dr. Fink, of Berlin, has devised a regulating nipple (which is shown in fig. 2), the object of which is to control the rate of flow of the gas without any diminishing of the pressure. In these figures, D is the lever or index hand of the tap C traversing the scale E and altering the position of a conical needle by the eccentric movement of the tap on the cone A. Once the right position of the regulating nipple for the flame required has been ascertained, the same flame may be again and again produced by merely bringing the index-hand of the tap to the same position on the scale. The needle moving to and fro in the nipple, serves also to keep the latter free from obstruction. The orifice in the nipple is of as small diameter as will serve for the largest flame which will be required for the work to which the particular burner is put. The burners used must be constructed to exact dimensions. It is important, for most purposes, that the mixture of gas and air should be warmed before combustion in a properly constructed massive cast-iron rose head, as shown in the burners in figs. 3 and 4. The rose head becomes red hot, and the gaseous mixture passing through the fine holes becomes superheated, and thus the maximum heating effect is secured. Burners of this type are applicable to the

Fig. 3.—High-Pressure Gas-Burner for Type-Setting Machine.

Fig. 4.—Burner for Small Pots in Type-Foundries.

heating of type foundries and type-setting machines, brass foundries, gold and copper smiths' furnaces, and braziers' and other metal workers' apparatus. One type foundry at Berlin uses 120 of these burners, and another 200, while a third type foundry at Leipzig also has an installation of 120 burners. In these type foundries, an economy of 30 per cent. in the gas consumed was attained when the change was made from low to high pressure gas. Type metal melts at a temperature of 797° Fahr.; but for the other metal-working processes referred to, temperatures of 2200° Fahr. and over are needed. For many of these purposes, it is impossible to prescribe a universal type of high-pressure gas-burner, since the particular form must depend upon the special requirements of each factory.

Special forms of burners are used for heating soldering bits and for brazing. A blow-pipe flame is secured without a high-pressure air supply, as the necessary air is drawn in automatically at the base of the burner. These blow-pipes, or blast-burners, are much more convenient than the old type with compressed air and low-pressure gas. At the Opel Motor-Car Works in Berlin, a copper tube 0·32 × 0·06 inch was fused in barely one minute, and at the same works heavy soldering bits weighing nearly 3½ lbs. have been replaced by the comparatively light high-pressure blast-burner. Generally speaking, for workshop use, high-pressure gas is superseding coal-fires or low-pressure gas used in conjunction with an air-blast, as the cost of the air-blast pipes is avoided, and the requisite flame temperature can be attained much more certainly and be more easily controlled. High-pressure gas is also generally applicable to smiths' work, and is cleaner, more convenient, and more rapid than the ordinary smiths' hearth, while the temperature attained can be more precisely regulated. High-pressure gas also is largely used for muffle furnaces, where it takes the place of low-pressure gas used in conjunction with compressed air.

These furnaces are applicable to all descriptions of hardening, annealing, and case-hardening of metals and to enamelling, and in the manufacture of metallic filaments for electric lamps. For furnaces for the finer classes of work of this description, the burners used must be of the blowpipe pattern, but provided with the regulating nipple already described, in order to ensure precision in regulating the flow of gas and, as a result thereof, the temperature attained. The high-pressure gas-burner of suitable pattern may be introduced for the heating of existing muffle furnaces which have hitherto been heated with gas at ordinary pressure with an air-blast. Special furnaces are used for hardening steel tyres, as it is necessary in this instance to secure uniform heating of the steel, and at the same time to prevent the spent gases coming in contact with the metal. Other special furnaces are used for raising sheets and plates of metal to a red heat for working prior to hardening, as in this case it is not necessary to avoid contact of the gases with the metal, and consequently a more economical type of furnace than the muffle, and one more adaptable to objects of different shape and size, may be employed. Crucible furnaces for high-pressure gas are also applicable to the melting of metals of all kinds, and especially gold, silver, copper, and brass. Similar furnaces may be employed for melting large quantities of more readily fusible metal (such as lead), in which

case graphite crucibles prove the most durable, or for the hardening of fine steel objects, for which apparatus the bath consists of a crucible of steel or wrought iron. Oil baths, working at a temperature of upwards of 570° Fahr., for tempering and annealing articles of steel may advantageously be heated by high-pressure gas, as a very uniform temperature may be maintained thereby, if the burners are distributed equally on both sides of the bath. Special high-pressure gas-furnaces are also employed for the brazing of steel and other tubes. In railway carriage and locomotive shops, the experiments hitherto made in Germany with the use of high-pressure gas for shrinking-on and removing wheel tyres have not proved very satisfactory, but it is hoped that a new type of burner will give good results. Boiling burners and smoothing irons may be heated with advantage by high-pressure gas in workshops in which it is available; and, provided a proper regulating nipple is used, considerable economy of gas consumption is secured.

The high-pressure gas-burners for heating apparatus referred to by the author are intended to work with gas at the same pressure—namely, about 4 inches of mercury, or 55 inches of water—as high-pressure burners for lighting purposes. This has the advantage that the high-pressure burners for industrial heating may be supplied from the same service pipes as the lighting burners, and only one small compressor is needed for the compression of the gas for both purposes. Since high-pressure gas for lighting effects an economy of 50 per cent. over gas at ordinary pressures, it is desirable to secure this economy by employing high-pressure gas-lighting wherever a high-pressure gas supply is adopted for industrial heating.

EXTRACTING CYANOGEN FROM COAL GAS.

Remarks on Mr. Mueller's Paper.

In the "JOURNAL" for the 20th ult. (p. 851), we gave the text of a paper on the above subject read by Mr. M. E. Mueller, of New York, before the American Gas Institute, at the last annual meeting. The paper elicited the following remarks.

Mr. W. H. FULWEILER pointed out that, from the fact that cyanogen does not generally exist in the illuminating gas which reaches the consumer to such an extent that its presence amounts to a serious impurity, its removal had not awakened the interest in America that it had done in other countries. He thought it would be interesting if the author told them the amount of labour required in the operation of the plant, including its supervision. Apparently, four reactions were taking place, the economical control of which seemed to require some technical oversight—viz., the formation of the ferrous sulphide, the saturation of the mud in the washer, the neutralization of the mud, and the neutralization of the wash-liquor. It seemed that improper or careless handling of any one of these processes would result in considerable loss of efficiency. In Germany, where the process was developed, technically trained men could be secured very much more cheaply than could be done in America; and therefore it would be interesting to know how much trained supervision was required. The fact that the practical results got at Astoria had shown that simultaneous high or low yields of both ammonia and cyanogen were more usual than the expected high cyanogen with low ammonia, or *vice versâ*, was certainly of great interest; and he should like to ask the author whether this was determined by the actual yields obtained from respective recovery plants or from tests made on the crude gas. If the former method was used, it was, of course, quite conceivable that variations in the efficiency of the operation of the plant might account for some, at all events, of this difference.

Mr. V. F. DEWEY remarked that Dr. Bunte [as recorded in the "JOURNAL" for June 28, 1910] had examined seventeen coals, and apportioned the nitrogen as follows: In coke, 60 per cent.; in uncombined nitrogen in gas, 20 per cent.; as ammonia in gas, 15 per cent.; as cyanogen in gas, 3 per cent.; in tar, 2 per cent. From the general trend of the paper, the high initial cost of the apparatus, and the high cost of maintenance, cyanide extraction would seem to be of doubtful desirability for ordinary plants unless the life of the purifying material were largely increased thereby. Generally speaking, one would expect the largest amounts of cyanogen to be produced at the works where the heats were highest, and more particularly where there were limited areas of high heats, such as hot zones in retorts, or one stand-pipe serving for three retorts. The fact that no relation seemed to exist between the ammonia and cyanogen yields might indicate that other reactions than those mentioned in the paper took place in the retorts. However, low ammonia yields in conjunction with high cyanogen yields had been observed in various places. He should like to ask if the cyanogen yield, estimated as a percentage of the ammonia yield, varied. In the same gas-works, under the same conditions, this percentage should be constant. This would explain Mr. Mueller's phenomena of high ammonia yields coupled with high cyanogen yields, and conversely. The author's method for the estimation of ferrocyanide did not, according to the various authorities, give results even approximately proportional to the amount of ferrocyanide present. For instance, if one sample of press cake contained 10 per cent. of ferrocyanide and another 20 per cent., the latter would not take exactly twice as much zinc sulphate solution to arrive at the end-point as the first sample. In fact, the ratios might vary widely. This was thought to be due to the existence of various ferrocyanides of zinc found under different conditions. This was all the more a decept.ve method, as two samples of press cake containing the same amounts of ferrocyanide—duplicates of the same sample, as a matter of fact—would check very closely indeed.

Mr. MUELLER, in reply to the observations made, said that Mr. Fulweiler had asked a question about the labour required in connection with the cyanogen-extraction process. As they were then running at Astoria—making about 12 million cubic feet of gas a day—the labour required was one foreman, four men on the filter-presses, one man to attend the washers and do the pumping on the washers, two men to crystallize the sulphate, dry, and bag it, one general man who attended to minor repairs, and one night man—a total of ten men. The same force would be sufficient for a make of about 15 million cubic feet a day. This was only the labour required in the actual operation. It did not include the repairs, which were heavy, both on the washers and on the other apparatus used in the finishing-up of the work. Mr. Fulweiler also remarked that the reactions appeared to be complicated, and would require a considerable amount of supervision. But after the men became accustomed to the work, they found it was very simple. It was only when things went wrong—for instance, if they opened the wrong valve, or pumped things into the wrong tank—that it caused considerable trouble to straighten things out again. With regard to the ammonia and cyanogen, it was not his intention to convey the idea that a high cyanogen yield always accompanied a high ammonia yield; but, on the other hand, he merely wanted to refute the general impression that a high cyanogen yield was obtained at the expense of the ammonia. When he spoke of cyanogen yield, he meant the actual cyanogen contained in the gas, and not the yield of the precipitate obtained, which, of course, differed with the efficiency with which the washers were being operated. Mr. Fulweiler also inquired about the return from the ammonia in the press cake. He might say that the ammonia in this form was about the same as in the crude liquor. As to the minimum installation that would pay, he was hardly prepared to say, because the incidental advantages accruing from extracting cyanogen were a little hard to take into consideration. But he did not think it would pay to extract it in plant making less than 2 millions a day. Of course, this figure was only an estimate. Mr. Dewey took exception to the method used for analyzing and testing cyanogen and analyzing the press cake. All he could say in defence of the method was that it was the one which had been adopted between them and the purchasers of the material; and it had been found satisfactory. He himself had great faith in it.

"Transactions" of the Société Technique.

We have received the volume of proceedings of the Société Technique du Gaz en France for the past year. It contains the report of the thirty-seventh annual congress, held in Paris from the 20th to the 23rd of June last, under the presidency of M. Auguste Godinet, of Lyons, and an account of the subsequent visit to Brussels, where the members received a cordial welcome from M. Prisse, the President, and their colleagues in the Belgian Association of Gas Managers, under whose guidance they visited the portions of the Exhibition of special interest to them. Most of the technical matter in the volume has already been noticed in the "JOURNAL;" and descriptions have been given of the five gas-works—two in Paris and three in Brussels—visited during the week of the meeting. The papers are illustrated by numerous diagrams and by 27 plates; and plans accompany the descriptions of the two Paris Gas-Works. The book contains a report of some trials of gas-heating appliances carried out at the Conservatoire des Arts et Métiers at the request of the Society. Particulars are furnished of the competitions for the prizes for the current session, the names of the recipients of those already awarded are given, as well as the names and addresses of the members, &c. The President for the year is M. Marquisan, a Director of the Gas and Electricity Company of Marseilles. In a supplement will be found a further collection of technical abstracts (commenced in 1908 by M. Payet) made by M. Bouron, the Permanent Secretary of the Society, together with a tabulated synopsis of the subjects dealt with in the present volume and its two predecessors. This is followed by a review of the legal business of the year 1908-9 by M. de la Taste; and the index to the cases noticed as far back as 1884 is brought up to date. The volume has been produced under the supervision of M. Bouron.

Altitude and Gas-Engine Capacity.—Some time ago a large gas-engine plant was exported to a British colony and erected at a place situated several thousand feet above the sea. The engines did not give the power expected from them; and various reasons were advanced to account for the deficiency. The final conclusion arrived at was that the loss of power was due to the altitude of the station; and Mr. Ralph Wolfenden was asked to investigate this effect on the power of a gas-engine. He complied with the request; and the results were contained in a recent number of the "Engineering Review." The conclusion arrived at was that the effect of increase of elevation on an engine with a low ratio of compression is slightly less than on one with a high degree of compression. But, for practical purposes, it appears that an allowance of 1 per cent. loss of indicated horse power for each 1000 feet increase of elevation is quite a safe value to adopt in, practically speaking, all cases.

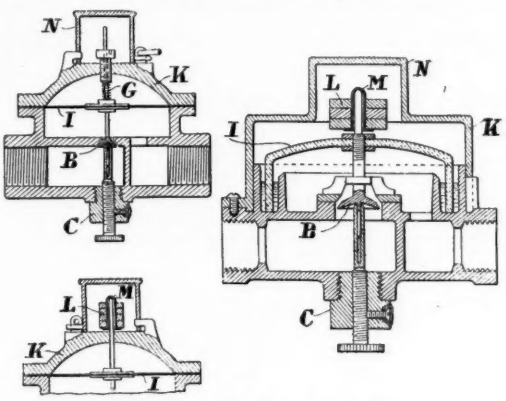
REGISTER OF PATENTS.

Automatic Gas-Governors.

HANSFORD, J., of New Barnet, and WRIGHT, A. C., of Witton, near Birmingham.

No. 25,660; Nov. 6, 1909.

These automatic gas-governors are of the kind in which the delivery pressure of the gas is regulated by a valve through which the gas passes from the supply to the delivery side of the governor, and which is urged away from its seating by a weight or spring, and towards its seating by the pressure of the gas after passing through the valve acting directly upon a flexible diaphragm or its equivalent. The governors are provided with means whereby the lift of the valve can be regulated from outside the casing, or the valve completely closed if desired, so that repairs or adjustments can be effected without cutting off the gas from the supply pipe to which the governor is fitted.



Hansford and Wright's Gas-Governors.

The illustration shows first the governor with the ordinary flexible diaphragm, also a part view with a slightly modified construction of same; secondly, a governor of the mercury type.

The governor casing in this diaphragm form is pierced at a point opposite to the valve B in line with the direction of its movement, and is fitted with a screw plug C in which is a pin, by screwing which more or less towards the valve, the maximum extent to which the latter can be displaced from its seating may be regulated as desired. The plug is preferably countersunk to receive the head of a set-screw and a lead seal which is run in around the head of the screw. The upper end of the pin is bored axially to accommodate a pin depending from the valve and thereby guide the valve in its movement.

The valve is loaded by a spring G, which is compressed between a nut securing the diaphragm I to the valve spindle and a hollow pin screwed into the cover K coaxially with the valve spindle which passes up through the bore in the pin. The head of the pin is so shaped as to enable the pin to be screwed more or less into the governor casing, and thereby compress the spring to a greater or less extent and so adjust the load on the diaphragm which determines the pressure at which the governor will come into operation.

Alternatively, the diaphragm and valve may be loaded by means of weights L carried by a flanged sleeve M suspended on the end of the valve spindle, which for this purpose is arranged to project beyond the cover K of the governor. In the case of governors set for high pressure, the valve may be loaded both by a spring as well as by weights.

The governor, of the mercury type, is an inverted cup the edge of which dips into a trough to contain the mercury, and is the equivalent of the diaphragm. But apart from this difference, the regulating device and other adjustments are identical with the other devices, except so far as regards the locking of the cap N.

Lighting and Extinguishing Gas-Burners at Predetermined Times.

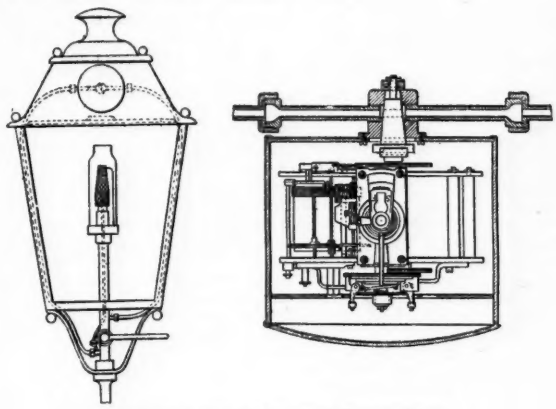
HANZER, C. & P., of Ivry-sur-Seine, France.

No. 26,702; Nov. 17, 1909.

This invention relates to apparatus in which the gas can be passed to the burner either through a valve operated by clockwork at the predetermined time, or through other passages independent of the clockwork controlled valve.

The apparatus (as shown) comprises an auxiliary tap or valve disposed in a branch pipe leading from below the ordinary tap of the lamp and returning to a point above it; the plug of the auxiliary tap being operated alternately and automatically through the medium of a spring barrel to turn the gas on and off. There are two spring barrels—one to drive a time-indicating movement which actuates the parts which release the second barrel; while the second barrel actuates the auxiliary gas tap or valve when it is necessary to turn the gas full on to the burner, to shut off the gas supply, or to reduce it considerably in order to leave only a pilot flame burning. The second barrel is released by spring tappets of the time movement, which can be turned and set in notches opposite the required time divisions for effecting the lighting and extinction.

The apparatus is mounted with the clockwork movement and the auxiliary tap in the upper part of the lantern; the auxiliary tap being connected to two branch pipes, one of which leads from below the ordinary tap of the lamp and the other returns to the supply pipe at a point above the ordinary tap. The operation of the auxiliary tap is effected by a wheel of the driving mechanism being caused to make a quarter-revolution each time it is set in motion, owing to the ratio of its diameter to that of a pinion by which it is driven.



Hanzer's Lamp Lighter and Extinguisher.

The spring tappets for producing the ignition and extinction are mounted at the side of, and extend behind, the hour-disc. They are arranged to be shifted circularly and set in notches opposite suitable hour divisions for producing the ignition and extinction; and when thus set the tappets act at the required times upon the releasing parts of the second driving barrel.

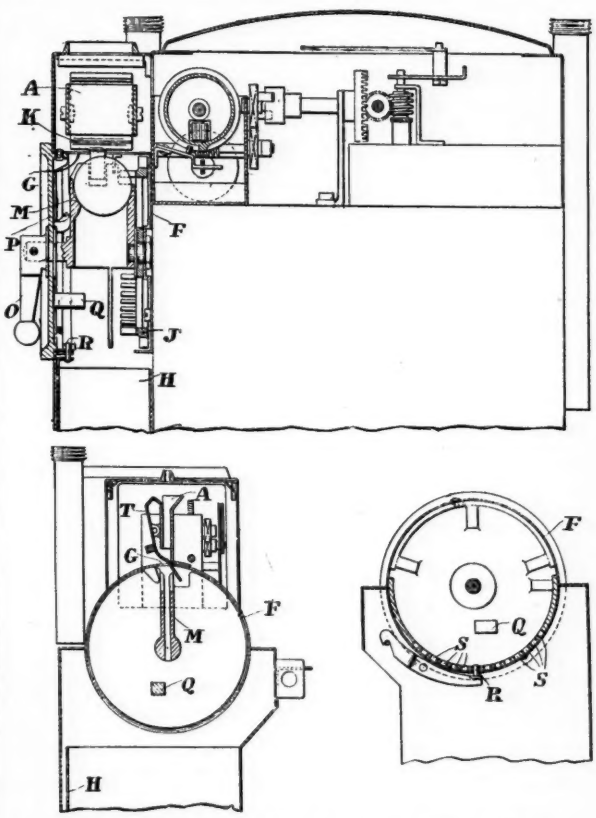
The releasing mechanism consists of a combination of levers, one of which is actuated by the tappets above named; the last of the levers being mounted on a spindle which likewise carries a lever serving (in the position of rest) as a stop or abutment for a pin mounted on a wheel in connection with the flyer of the second driving barrel. A tongue carried by the lever serves as a temporary stop to the flyer immediately after the release of the pin; and a disc formed with a notch is provided to serve as a lifter cam to permit of the rotation of the wheels of the second driving barrel, which finally effects the turning in one direction or the other of the plug of the auxiliary tap.

Prepayment Gas-Meters.

BERRY, J., and MAYLOR, J. A., of Oldham, and METERS LIMITED, of Manchester.

No. 28,736; Dec. 8, 1909.

This invention has for its object to prevent fraudulent tampering with the prepayment mechanism of a gas-meter through the coin shoot or slot, to allow of the ready adjustment by authorized persons of the pre-



Berry and Maylor's (Meters Limited) Prepayment Gas-Meter.

payment mechanism of the meter, to vary the amount of the delivery therefrom for each coin inserted, and to enable the prepayment mechanism to be removed from position without breaking the seal.

The prepayment mechanism comprises a box-like casing F (to which the gas-valve control mechanism is secured), having an inlet G through which coins are inserted, and a delivery aperture by which they pass to the receptacle H. Within the casing is mounted the usual spur-wheel J, having teeth both upon its peripheral edge, for engaging a spur-wheel K on the valve-controlling mechanism, and also upon its front face for engagement by the coin when passed through the shoot A. It enters the coin-holder M, secured upon the spindle of the usual setting handle O, by which the valve-mechanism is actuated for obtaining a delivery of gas according to the value of the coin inserted.

The plate P of the casing F has a stop Q on it for limiting the movement of the handle and coin-holder, so as to regulate the movement imparted to the valve-control mechanism according to the coin inserted. The plate P is secured in position by a bayonet joint, and by a pin R on a lever adapted to be passed through the fixed casing around the coin receptacle H into any one of a number of holes or apertures S in a ring-like projection upon the plate. By removing the pin which locks the face plate to the fixed casing, the plate can be given a rotary movement so as to adjust the position of the stop. The bayonet joint prevents the withdrawal of the face plate, except when it is in a certain position, while allowing of its partial rotation. After the desired amount of rotary movement (which regulates the quantity of gas delivered for each coin inserted, by varying the position of the stop), the locking pin is passed through one of the apertures S in the plate ring, so as to hold the plate stationary. The pin can only be manipulated from within the coin receptacle, "so that unauthorized alteration of the prepayment mechanism is prevented."

To prevent fraudulent manipulation of the prepayment mechanism by (say) inserting a knife blade through the coin-shoot and gradually rotating the spur-wheel J, there is pivoted upon the shoot a lever-like part T, one end of which is near the coin-receiving end of the shoot. The lever is arranged so that a coin in passing through the shoot first contacts with its upper end, when the lower end is forced across and obstructs the shoot; and then it contacts with the lower end of the lever, when the upper end is forced across, and obstructs, the shoot. When the coin-holder M is not in position to receive a coin from the shoot, the peripheral edge of a circular plate attached to it prevents the passage of the coin from the shoot.

When it is desired to remove the prepayment mechanism from position, the face-plate P is withdrawn, and the screws, which hold the casing F to the meter, slackened back, when the whole of the prepayment mechanism (including the gas-valve control mechanism and the coin-shoot guard) is loose and detachable, without affecting the recording mechanism and without breaking any seals upon the meter.

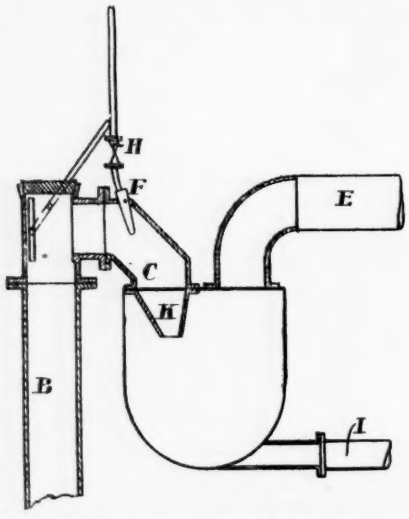
Dry Distillation of Coal and Preventing the Formation of Thick Tar.

JOHNSON, J. Y.; a communication from the Maschinen und Armaturenfabrik, vorm. Breuer and Co., of Höchst-on-Maine, Germany.

No. 29,125; Dec. 13, 1909.

This apparatus is intended to prevent the formation of thick tar in the manufacture of gas by the dry distillation of coal, and is of the type in which liquid is introduced into the hydraulic main with the effect of diluting the tar.

The apparatus is provided with a jet under pressure arranged in the dip-pipe so close to the hydraulic main as to effect agitation. Thus there is introduced into the hydraulic main, at as many places as there are dip-pipes, a powerful jet of (say) thin tar, tar water, or the like, which sets in constant motion the tar which forms, and at the same time maintains it in such a thin fluid state that it will flow out of the hydraulic main of its own accord. The jet exerts a suction action on the gas and draws the gas from the retorts more or less powerfully according to the supply of the liquid.



Apparatus for Preventing Thick Tar in Hydraulics.

The maintenance of a constant pressure in the distillation spaces of the retorts, the patentee remarks, is "of special importance; for if depression occurs, atmospheric air will be drawn in through any leaky places of the retorts, and burn some of the material undergoing distillation—a large amount of carbon dioxide being thereby produced. . . . The prevention of the formation of carbon dioxide is of special importance for the further treatment of the gases and of the ammoniacal liquor obtained therefrom. This applies more particularly to the production of concentrated ammonia, sal-ammoniac, or compressed ammonia."

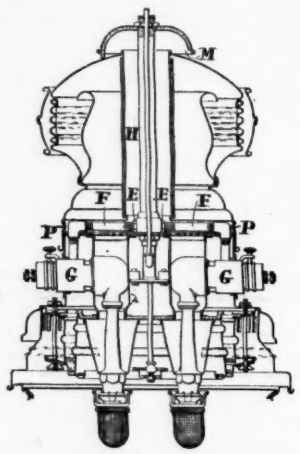
In the arrangement shown for carrying out the process, the gas leaving the retort by the ascension pipe B passes through a connection piece C to the hydraulic main, and thence to the gas-suction pipe E. Into the connection piece C opens the nozzle F of a pipe for the thin tar, tar water, or the like. The valve H in the pipe enables the quantity of liquid, and also the strength of the jet, to be regulated. The liquid impinges with great force against the bottom of the hydraulic main, and by its constant motion prevents the formation of thick tar and at the same time so dilutes the tar which separates that it can automatically flow out with the cleansing liquid. This takes place through a pipe I arranged at the lowest part of the hydraulic. The effective cross sectional area of the connection piece C can be enlarged or decreased by a regulating device provided at K.

Inverted Incandescent Gas-Lamps.

ANDERSON, D., of Farringdon Road, E.C.

No. 28,366; Dec. 4, 1909. No. 1029; Jan. 14, 1910.

This combined invention has for its object to construct a lamp in which the conditions under which the mixture of gas and air is burnt are maintained constant as far as is possible.



Anderson's Inverted Incandescent Gas-Lamp.

As shown, the multiple-burner lamp is provided with a central pipe, at the lower end of which are gas connections E and pipes F, by which the gas is led to the mixing tubes G. Practically the whole of the vertical portion of the gas-pipe is in a chamber H, formed by a casing concentric with the pipe and covered with asbestos. At the upper end of the chamber H, a vent M leads outwards and then downwards to the atmosphere; and at the bottom end of the chamber are horizontal passages surrounding the gas-pipes F and extending in a radial direction. Cold air enters the ports P and passes through them into the chamber surrounding the vertical gas-pipe.

A continuous current of cool air will thus be caused to flow upward through the chamber so as to keep the gas supply cool until it comes within a short distance in the vertical direction of the tube, in which it is mixed with heated air as described in patent No. 7486 of 1909. The inventor finds that the pressure of the gas at the burner is, in this way, greatly improved; "the effect of the long, vertical pipe leading through the lamp, and the bad effects on the pressure of a long, vertical gas-pipe in which the gas is heated, being completely avoided."

Distillation of Coal.

RUTHENBURG, M., of Kingsway, London.

No. 29,328; Dec. 15, 1909.

In order to more completely eliminate sulphur or other impurities from the coke, resulting from the distillation of coal, the patentee proposes to submit the heated charge in the retort (when either partially or completely coked) to the action of an electric current. Suitable electrodes, capable of withstanding the heat, are attached to portions of the retort—say, one at each end—or else inserted in the material forming the charge when it is introduced; the arrangement in all cases being such that the current passes through the charge. The current may be furnished, the patentee mentions, by any convenient source of power—for instance, the gases from the retort may be used in an internal combustion engine, or may be employed to raise steam for a steam-engine; the engine in either case being used to drive a dynamo or alternator. The process, he says, is "found to be efficient and to secure a more thorough and complete elimination of the sulphur or other impurities." His claim is: "In the distillation of coal, driving off the sulphur or other impurities remaining in the coke by passing a current of electricity through the partially or completely coked charge."

Gas-Lamps.

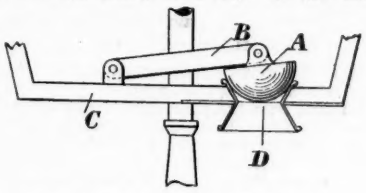
GLOVER, R. B. G., of Edmonton, N.

No. 641; Jan. 10, 1910.

This invention relates to the flaps or closing appliances for torch holes in street gas-lamps, whereby the portion fitting the torch-hole will always find a proper seating and cannot become bent or damaged by the torch.

The closing appliance is a half sphere A, hinged to a short bar B,

which is pivoted to the lamp frame C and controlled (or not) by a spring to normally keep the half sphere in or on the torch hole D. The hole has splayed-out walls or ends for ready and easy insertion of the



Glover's Street-Lamp Torch-Hole.

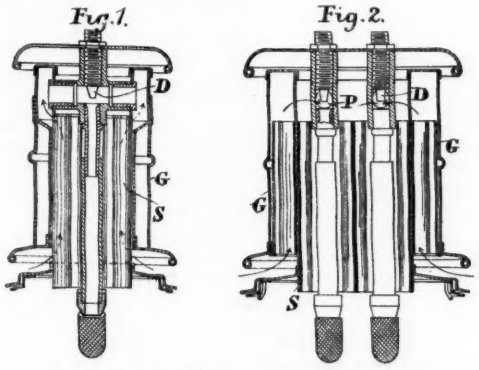
torch, and for a ready and easy fitting of the half sphere, which readily adjusts itself to the movement of the torch and also properly positions itself in or on the torch hole, so as to effectually close it.

Inverted Incandescent Lamp Worked by Compressed Gas or Air.

DEUTSCHE GASGLÜHLICHT AKTIENGESELLSCHAFT (AUERGESELLSCHAFT), of Berlin.

No. 715; Jan. 11, 1910. Date claimed under International Convention, Oct. 13, 1909.

The subject of this invention is an inverted lamp for incandescent gas-lighting worked by compressed gas or compressed air with the feature that the entering of secondary air above the frame of the globe is avoided and the primary air is "preheated to the highest possible temperature" outside the chimney. For this purpose, the combustion chamber is isolated from the outer air above the frame of the globe, and the width of the chimney is kept "exactly sufficient to allow the gases of combustion to pass through."



Auergesellschaft's Inverted Incandescent Lamp.

The combustion chamber of the one-light lamp in fig. 1 is isolated from the outer air at the bottom and at the side by a globe, and towards the top by the reflector, so that when working the lamp secondary air cannot reach the flame, and the chimney S only allows the escaping gases of combustion to pass. The primary air rises on the outside of the chimney between it and the casing G (as shown by the arrows), is highly preheated in its passage by the sides of the chimney, enters the mixing-pipe, and there joins the gas from the nipple D. The walls of the chimney are corrugated, so as to achieve preheating to the highest possible extent.

Fig. 2 shows a two-light lamp in which the chimney S is made oval in order to render the section proportionate to the gas consumption. It is provided with inside and outside ribs for the purpose of producing a larger surface. The primary air rises over the outer ribs and enters through the tubes P to the gas escaping through the nipples D. The combustion chamber is closed laterally by the usual globe and on the top by a reflector. The globe may at the lowest part have a small hole, which allows an escape to any products of condensation, and also permits the lamp to be lighted from below without touching it. The casing G may be surrounded by another casing, so that between them a space with stagnant air is formed.

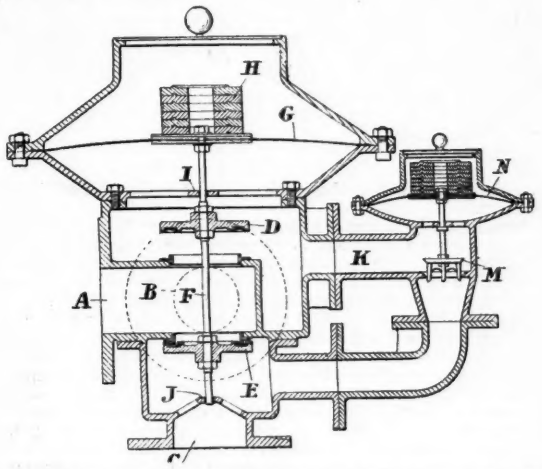
Controlling Combined High and Low Pressure Gas Supplies.

BERRY, J., of Oldham, and METERS LIMITED, of Manchester.

No. 1069; Jan. 15, 1910.

This invention relates to means of controlling high and low pressure gas supply pipes in such a manner that when the high-pressure gas supply exceeds a predetermined degree of pressure the low-pressure supply is cut off from the service mains; but when the high-pressure supply falls below the predetermined pressure, the low-pressure supply is admitted to the mains, so that under all conditions a supply of gas at either high or low pressure is provided.

The valve casing has an outlet A, and two inlets—one B for connection to the source of high-pressure gas, and the other C for connection to the gasholder or supply of low-pressure gas. Communication between the inlets and outlet is controlled by two valves D E mounted on a spindle F connected to a diaphragm G, which, at its upper side, is in communication with the atmosphere, but at the other side is acted on by the high-pressure gas supply. When the high-pressure gas supply exceeds a predetermined degree of pressure and moves the diaphragm against the action of the weights H (or a spring), the high-pressure gas-inlet valve D is opened and the low-pressure gas-valve E closed—thus providing for a flow of high-pressure gas to the service main. But should the pressure of the high-pressure gas supply be insufficient to maintain the diaphragm in the position shown against the action of the weights, the latter will move the diaphragm, close the valve D, and open the valve E, thereby providing a low-pressure gas-supply to the service main.



Berry's (Meters Limited) Combined Highland Low Pressure Controller.

As it is sometimes desirable, the patentees mention, to maintain the gas-compressor running at a constant speed, notwithstanding variations in the consumption of gas from the service main, there is a bye-pass or passage K between the inlets B and C, through which, when the high-pressure gas supply exceeds a predetermined pressure, gas can flow back to the holder from which the compressor is fed. On the passage K is a valve, as M, preferably controlled by a weighted diaphragm N in a similar manner to the inlet valves D.

Gas-Meters.

HIBBERD, C. E., of Victoria Street, S.W.

No. 5776; March 8, 1910.

This invention has for its object to provide means for overcoming the difficulties due to condensation in meter measuring chambers. It has hitherto been proposed so to dispose the gas inlets and outlets in a meter in their relations to the controlling valve or valves that the liquids on condensation flow from and through the meter and its valves in a direction opposite to that in which the gas flows, at all times, without sealing the ports or passages; but this arrangement has "necessitateda special disposition of the gas-pipes of the main supply and house or other system."

Hibberd's Gas-Meter Measuring Chamber.

The suggested arrangement consists broadly in a gas-meter measuring chamber, provided with means whereby condensed products within the chamber are allowed to collect without affecting the accuracy of the meter, by providing a receptacle into which they may flow, and means whereby the collection of them may be prevented from affecting the stroke of the membrane.

The base of a chamber of the nature referred to is shown, with a channel-like recess Q upon each of the walls of the chamber. The inclined wall R is recessed, and a strip of tin R^1 is soldered over in such a manner as to allow the membrane, when clamped in position, to swing to either side, and (when in its extreme position) closely to abut against the whole of the sloping side R and R^1, while allowing sufficient clearance for the condensation within the chamber to collect in the receptacle at Q. Thus condensed products flowing down will pass into this chamber, and will not interfere with, or act to decrease, the stroke, and consequently the capacity of the measuring chambers.

Conveyors.

MARCUS, H., of Cologne-on-the-Rhine.

No. 6815; March 18, 1910.

This invention relates to the driving mechanism for conveyors used to impart "propeller motion" to conveyor trough, as graphically represented in fig. 1 (p. 46), from which it appears that the reciprocating trough is moved relatively slowly near the rear end position C, that the velocity of movement increases on the forward stroke until the point D is reached, and that then the movement proceeds rapidly up to the forward end position E, where the movement is reversed; the velocity on the return stroke of the conveyor trough proceeding symmetrically with that on the forward stroke from E to F, and thence diminishing to C. The abscissæ represent the distances traversed by the conveyor.

To obtain a maximum of impulse for conveying the material, the velocity represented on the diagram proceeds with approximately uniformly accelerated movement of the trough on the first and main part of the forward stroke, and with approximately uniformly retarded

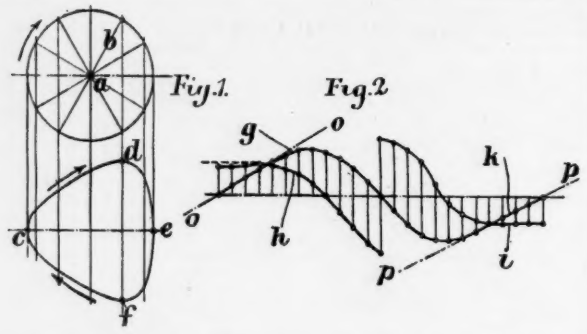


Fig.1. Fig.2

movement on the return stroke, combined all through with a quick return movement.

It has already been proposed to drive a conveyor by means of mechanism comprising a crank and a connecting rod of a length less than four times—*e.g.*, from three-and-a-half to two-and-a-half times—the length of the crank; the mechanism being connected to the trough through the intermediary of a link or links pivoted at one end.

For imparting a "propeller" motion to the conveyor trough, the patentee adopts mechanism of this known character, but designs it so that the link or links shall be approximately vertical when in mid position, whereby he provides horizontal guidance for the point of engagement of the connecting rod with the link or links. Alternately, he provides a rectilinear guide for the outer end of the connecting rod, and dispenses with the link or links; or, using a connecting rod of greater length, and disposing the links so that they shall be inclined to the vertical when in mid position, he arranges that the point of connection of the rod with the trough shall be substantially at the same level as the axis of oscillation of the links.

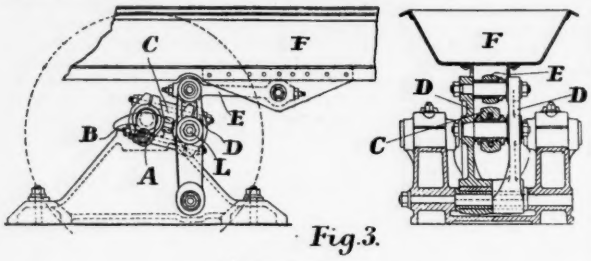


Fig.3.

Marcus Conveyors.

A construction embodying the invention is shown in fig. 3; fig. 2 representing the corresponding velocity and acceleration diagram in which the abscissæ represent equal time intervals.

Referring to fig. 3, the uniform rotation of the crank shaft A and of the crank B is, with the aid of the short connecting rod C, which in the present case is about three times the length of the crank, converted into an oscillatory movement of the link or pair of links D mounted to oscillate at the lower end, and so arranged that they will be approximately vertical when in mid position. The upper end of the link D is connected to the conveyor trough F through the intermediary of the connection E.

On the forward movement of the trough, it, together with the material resting on it, has been accelerated approximately uniformly over a considerable part of its stroke, so that the velocity increases approximately uniformly, as appears from fig. 2. In this figure, the velocity curve *g* and the acceleration curve *h* are applicable to the movement of the conveyor as operated by the mechanism. The first part of the acceleration curve *h* is an approximately horizontal line, and, accordingly, the first part of the velocity curve *g* approximates to the straight line *o*—*o*. In the last part of the stroke, the movement of the trough is retarded and is rapidly brought to zero, as denoted by the curve *g*, so that the material is shot forward. While this is occurring, the trough is retracted rapidly, and then retarded with the uniform retardation until the rear dead-centre is reached and the material in the trough is again at rest. From fig. 2 it is obvious that the latter part of the return movement, as shown by the curve *i*, is performed with approximately uniform retardation; so that the velocity curve *k* approximates to the straight line *p*—*p*.

The point of engagement *l* of the short connecting rod to the link *d* lies on an arc of only a slight curvature—*i.e.*, approximating to a straight line. A rectilinear guide may be provided for the outer end of the connecting rod in lieu of a curved guide, in which case the pivoted links *d* are dispensed with.

Automatically Opening and Closing Cocks, Valves, &c.

HOWLIN, W., of Newtown, near Sydney, New South Wales.

No. 15,398; June 27, 1910.

This invention relates to apparatus such as that described in patent No. 23,826 of 1905 whereby cocks, valves, electric switches, and the like, are opened or closed at predetermined times by clockwork. The object of the invention is "to reduce the size, and simplify the mechanism, for effecting the necessary movement of the cock or switch, and at the same time render it more reliable in operation." The arrangement employed comprises time-setting means to be used in combination with clockwork mechanism which supplies the power necessary to obtain the needful movement of either of two levers, which, in turn, at a predetermined time, is caused to give a blow to one of two levers pivoted on a crank lever secured to the plug or stem of the cock or switch, sufficient to instantly throw it to the "on" or "off" position as the case may be.

Pyrophoric Metal Alloys.

BECK, H., of Niederschöneweide, near Berlin.

No. 15,507; June 28, 1910. Date claimed under International Convention, July 1, 1909.

This invention relates to improvements on patent No. 2876 of 1910 [see "JOURNAL" for the 27th ult., p. 937].

Recent experiments with the pyrophoric metal alloys of the rare earth metals and quicksilver have shown, the patentee says, that the high pyrophoricity of these alloys can, by suitable additions of various kinds, be influenced to any desired extent and in any desired manner. For example, it was found that the rare earth metals in their quicksilver alloys can be partly replaced by the easily fusible metals calcium, magnesium, zinc, cadmium, aluminium, lead, tin, and bismuth; by the metals which are more difficult to fuse—such as copper, manganese, chromium, molybdenum, tungsten, uranium, iron, nickel, and cobalt; or by a mixture of any or all of these metals with each other—without certain pyrophoric properties of the quicksilver alloys, such as the capability of igniting themselves in the air, being entirely destroyed. The choice and percentages of the addition of one of the said metals, or of the mixture of metals, will in each particular case depend on the required pyrophoric effect.

A substitution, for example, of from 5 to 15 per cent. of the rare earth metals by cadmium, aluminium, or tin, may result in a diminution of the pyrophoric power, inasmuch as the self-ignition in the air, with an intense glow and the formation of sparks, does not take place until after a short period of action of the oxygen of the air, as compared with the pure quicksilver alloys of the rare earth metals which ignite instantaneously on coming in contact with the air. By unduly increasing the addition of the metals, the capacity of the alloy for self-ignition entirely disappears. A far higher percentage of one of the above-mentioned metals, which are difficult to fuse, may be added without the pyrophoric power of the quicksilver alloys being in the least diminished. The alloys, for instance, even when 50 per cent. of the rare earth metals is replaced by copper, uranium, or nickel, still show the remarkable peculiarity that, on contact with the air, they ignite themselves instantaneously—thereby producing a powerful light and an extremely great heat with an intensive spluttering of sparks. A gradual diminution of the pyrophoricity occurs on further replacing more than 50 per cent. of the rare earth metals by the before-mentioned metals; but on exceeding about 85 per cent. as the percentage of copper, uranium, and nickel, the characteristic self-igniting property entirely disappears.

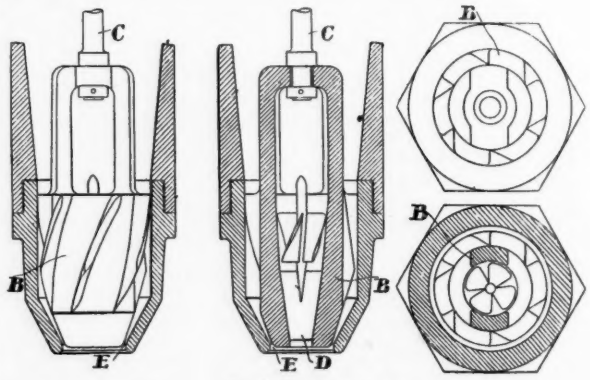
It was further found that considerable additions of any non-metallic substances which, at the alloying-temperature of the quicksilver alloys of the rare earth metals, show no chemical reaction upon these, do not in any way injuriously influence the pyrophoric action (for example, kieselguhr, fine sand, clay, and the like). This kind of cheap additions, which reduce the cost of producing pyrophoric substances to a still more considerable extent than the metallic additions described in the foregoing statement, would appear to be of the greatest importance for the technical utilization of the pyrophoric quicksilver alloys.

Separating Tar from Gases.

OTTO-HILGENSTOCK COKE-OVEN COMPANY, LIMITED, of Crigglestone, near Wakefield; a communication from Dr. C. Otto and Co., G.m.b.H., of Dahlhausen a.d. Ruhr, Germany.

No. 17,548; July 23, 1910.

In their specification, the patentees remark: In the practice of separating tar from gases by means of a spray of tar or of tar and ammoniacal liquor injected into the flowing gas, it is desirable to adapt the quantity of liquid to the volume of gas which happens to be passing at any given time. A mere adjustment of the quantity by throttling the supply pipe feeding the injector is inadmissible, because the speed of flow through the injector being thereby varied, the form of conical spray produced would be altered and become less efficient.



Otto's Tar Nozzle.

To vary the quantity of liquid which flows through the injector to suit the volume of gas passing at the time without substantially varying the speed of the liquid, the patentees propose to provide a nozzle with an orifice through which the liquid first passes, of such dimensions that it admits no more liquid than is necessary for separating the tar from the gas when the volume of gas passing at any time has been reduced to a minimum; while to increase the quantity of liquid, there is a separate adjustable annular orifice concentric with the first one.

The casing shown is connected with the supply of tar or ammoniacal liquor and tar under pressure; and within it is a nozzle B, the orifice

D of which is of fixed dimensions. The nozzle has external helical ribs which fit the casing closely, and form between them passages for liquid, which, however, are closed (or substantially closed) at E when the nozzle is home in the casing.

The liquid necessary for separating the tar from the gas when a volume of gas passing at any time has been reduced to a minimum, flows through the orifice D into the pressure cone of the injector, after having received a twisting movement from the nozzle. When the volume of gas passing increases and a larger quantity of liquid becomes necessary, the nozzle is lifted by its stem C so that an annular orifice is formed at E through which liquid flows, having received twisting movement as before from the external ribs on the nozzle. Thus the annular jet unites with the central jet without destroying the latter.

APPLICATIONS FOR LETTERS PATENT.

29,411.—Wilkinson, G., "Automatic removal of air and gas from vessels containing steam, water, and the like." Dec. 19.
29,431.—Hartness, J. B., "Su tion gas-producers." Dec. 19.
29,453.—Kelley, J. H., "Automatic burners." Dec. 19.
29,501.—Southey, A. W., "Production of gaseous fuel." Dec. 19.
29,522.—Burdon, J., W. M., & M. M., "Producing oil gas." Dec. 20.
29,548.—Wimshurst, E. J., "Combination ranges." Dec. 20.
29,624.—Judd, G. H., "Gas tap and regulator." Dec. 21.
29,644.—Barker, W. H., jun., "Conveyors for coal." Dec. 21.
29,646.—Lee, J., and Bailey, W. E., "Gas-stoves." Dec. 21.
29,656.—Matthews, W. C., "Mantles." Dec. 21.
29,671.—Aubert, A. M. & J. M., "Pilot-jet." Dec. 21.
29,673.—Evans, E. V., "Purification of gas." Dec. 21.
29,700.—Smith, E. H., and Kaatz, E. A., "Incandescent lamp regulator." Dec. 21.
29,705.—Groeling, A. F. G. C. P. J. von, and Smith-Rewse, H. S., "Distillation of petroleum oil and other hydrocarbons or the condensation of natural gases." Dec. 21.
29,709.—Stelfox, J. C., "Water-gas apparatus." Dec. 21.
29,812.—Tooth, L. F., "Atmospheric burner." Dec. 22.
29,813.—Pollock, C. V., "Gas-mixers." Dec. 22.
29,835.—Mahieu, M., "Connecting rubber pipes to metallic pipes." Dec. 22.
29,858.—Beal, W., Ltd., and Beard, A., "Ball-and-socket joints for gas-pendants." Dec. 23.
29,925.—Walker, C. & W., Ltd., and Bachelor, J. P., "Washing or purifying gas." Dec. 23.
29,935.—Coke-Oven Construction Company, Ltd., and Marr, J., "Recovery of bye-products formed during the gasification of coal." Dec. 23.
29,973.—Challis, J., and Stephens, K., "Inverted incandescent gas-lights." Dec. 24.
29,977.—Jackson, T., "Gas-lighted flash-signs." Dec. 24.
29,978.—Jackson, T., and Ramsay, A., "Gas-lighted flash-signs." Dec. 24.
29,996.—Booth, J. & J. R., "Packing mantles." Dec. 24.
30,013.—Hansford, J., and Wright, A. C., "Money-boxes for prepayment meters." Dec. 24.
30,021.—Glover, T., "Atmospheric burners." Dec. 24.
30,022.—Stone, J., and Co., Ltd., and Jakeman, G. E., "Nipples for connecting service-pipes to mains." Dec. 24.

A Point as to Water-Rates.

The Stourbridge Magistrates were last Friday called upon to decide a case in which Enoch Baugh was summoned by the Stourbridge and District Water Board for 19s. 3d., the water-rate for a previous residence. The evidence showed that Mr. Baugh changed his residence in the middle of a quarter, and went to another house in the water district; and he therefore contended that he should not be liable for paying for water at both houses. If a tenant had gone into the residence he left, he asked, would that tenant have had his water free for the rest of the quarter, or would the Board have charged both of them? The collector of the Board said it would have been open to Mr. Baugh to make a bargain with the tenant under the old Company; and he added that he used to divide the rate up in similar cases. But the Auditor, now that the undertaking was under a Board, insisted upon the Act of Parliament being followed. The Bench made an order for the payment; one Magistrate remarking that they made no comment upon the case, except that the law was against the defendant.

Lodgers and their Water Supply.

At the Lambeth Police Court, last Friday, before Mr. Baggallay, a point of interest to property owners arose upon a summons taken out by Inspector Weatheritt, on behalf of the Southwark Borough Council, against the owner of a house at Walworth for failing to comply with a notice by the Council requiring him to provide a proper and sufficient water supply to the upper part of the premises. The house in question, consisting of basement, ground floor, and first floor, is let by the owner to one tenant, who in turn sublet the basement and upper floor. A water supply is provided in the scullery and also on the ground floor. But the Council complained that the latter supply was not available to the tenants of the upper storey, who had to fetch their water from the scullery; and they asked that the owner should be ordered to fix a tap on the top floor. The Medical Officer of Health for the borough (Dr. George Millson) said he found that the occupiers of the upper floor only fetched up 6 gallons of water for their daily use, whereas they should use 22 gallons. Mr. Baggallay asked whether the tenants were in attendance to complain. Dr. Millson said they never complained. If they had only a pitcher full of water, they would not complain. His Worship thought the distance the tenants on the upper floor had to go for their water could not be considered unreasonable; and he dismissed the summons.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Brick and Concrete Gasholder Tanks.

Sir,—In your edition of Nov. 15, you print a reply by Mr. Frank H. Robinson to my criticisms on his paper. His letter causes me a conflict of emotions. I admire the friendly spirit of his discussion, and I find that I have a desire to know him better, and that there should exist between us those amenities that properly obtain between "cousins." However, our profession is a serious cause which imposes upon the constructing engineer responsibilities from which he cannot escape. The design and construction of a large gasholder is an undertaking much too great in magnitude to permit the employment of such primitive theories and methods as those advocated by Mr. Robinson. His analysis has no place in the engineering practice of the present time. Fellowship must yield to duty; and, hence, as his errors demand stern treatment, they shall get it.

In order to facilitate reference to his letter, I have given each paragraph of his communication an alphabetical designation.

Mr. Robinson states, in paragraph "B," that I question the value of 220 lbs. as the unit resistance of brickwork to tension. A reference to the reprint of my paper [p. 401 of the "Journal" for Nov. 8] will show that I raised no question whatever about his using such a unit stress, but merely referred to the fact. A statement of the unit resistance of brickwork cannot be confined to such a narrow range as the difference between 208 lbs. and 220 lbs. Without disputing Mr. Robinson's value, I merely modified it to accord with what experience has shown may be expected of American brick.

In paragraph "C," Mr. Robinson states:

> Mr. Alrich says, in reference to my methods of calculating the strength of masonry tanks by dividing the wall into segments, "the summation of the moments of stability of these was assumed as co-operating with the tensional resistance of the ring in resisting the bursting pressure."

From a reference to the top of p. 402, second column of the "Journal" for Nov. 8, it will be seen that Mr. Robinson's name was not mentioned in connection with the statement he quotes from my paper. My source of information regarding the Manchester tank is not confined to Mr. Robinson's paper; but even he implied in the first part of the discussion that Arson's method was used in the actual work of designing.

The method of computing, for which Mr. Robinson desires to be fully responsible, is stated in plain terms on p. 403 of the "Journal" for Nov. 8, and is there labelled with his name in order that there might be no possibility of mistake.

When he states that he does not believe any tension exists in the tank wall, he concedes that he does not know that all materials are elastic, and very perceptibly so.

It is rather difficult to discuss seriously the last sentence of paragraph "C." Even though the wall contained such orifices as would permit the water to flow freely through, all water in contact with the outer surfaces of the tank wall would exert an external hydrostatic pressure upon the face of the wall, regardless of the source from which the water was derived.

After having disposed of circumferential tension, Mr. Robinson says, in paragraph "D," that "some assistance is obtained from the circular form of the structure, and its properties as a monolith." Quite unconsciously, he stated in those few words the real essence of tensional resistance.

A number of engineers—including some of large experience in holder construction—have communicated to me their appreciation of the thoroughness with which the particular demonstration which Mr. Robinson requests in paragraph "E" was made in my paper. We will save some space by assuming that further discussion along that line is unnecessary.

In paragraph "F," Mr. Robinson assumes the resistance of clay to a vertically-applied load as being identical with that offered to a horizontally applied force. Such a property is true only either of a fluid or of a solid, such as rock. However, if Mr. Robinson proposes now to apply such an assumption as "3360 lbs. at the greatest depth, and nothing at the surface of the ground," he must revise the formula given in his paper as published in the "Journal" for Nov. 20, 1909, for the reason that the centre of gravity of the triangular pressure diagram would then be at one-third of the height of the tank wall, instead of at half as he has assumed. This revision of his figures will result in a further reduction of the factor of safety of 16. Reference to Dr. Pole's translation of Arson's analysis will show that it is specifically stated that the horizontal thrust of the earth-backing is assumed to be the same at all depths. An examination of Mr. Robinson's analysis proves that he assumed the same thing.

Passing now to paragraph "I," Mr. Robinson says, "The value of any formula is judged by the way it is borne out in practice." We may assume from this that since the Manchester tank has not failed, his method of calculation is correct He has conceded, however, that his analysis was not actually used in the design of the tank; hence, its only relation to the work is that of a tag attached to the finished structure. Quite plainly, any number of such tags may be attached. Mr. Robinson fails to establish any connection between the stability of the Manchester tank and his formula.

It is Mr. Robinson's impression, expressed in paragraph "J," that the tanks mentioned in my paper show a most extravagant use of material. He states that, with English practice, the walls of such tanks would be somewhat thinner. The fact that one of these tanks, the wall of which is 7 feet thick, resting on solid rock and surrounded by what appears to be rather firm soil, is cracked at a point half-way down, does not confirm his views. Apparently, all kinds of earth look alike to Mr. Robinson; nor does he realize that the behaviour of formations of different character vary widely from one another.

In paragraph "K," it is stated that I assumed in my calculations that there is a maximum ring-tension at approximately the centre of water pressure. No such statement appears in my paper; and any such relation Mr. Robinson may have discovered is purely accidental.

In paragraph "L," the amount of ellipticity that I discuss has been computed as being but 0·00041 of the total diameter. It is of no consequence whether the ellipticity be that amount or 0·0000041 of the length of London Bridge. The important fact is that such ellipticity results in a material increase in the stresses in the tank-shell, and so should be considered.

In the last paragraph, on p. 405 of the "JOURNAL" for Nov. 8, I directed attention to the inability of the buttresses to resist the overturning moment that Mr. Robinson assumed to be exerted against them. I am somewhat disappointed by his failure to explain from what source the additional resistance is supplied.

I do not wish my emphasis to be misunderstood, as indicating any feeling of rancour; but I do believe that large gasholders are structures of sufficient importance to deserve the best engineering practice of the present time being bestowed upon them. Analytical mechanics, as applied in such engineering practice, takes into account the elasticity of materials and conjugate stresses, as well as the theory of moments. Such considerations are not splitting hairs, as Mr. Robinson might think, but represent elements of such importance that their being ignored may result in failure.

I will repeat that in the construction of a masonry gasholder tank, located below the surface of the ground, the only form of failure to be averted is such cracking of the tank wall as will impair its tightness. Any such contingency, as one section of the wall being overthrown in the manner that Mr. Robinson assumes, is decidedly remote, as it could only occur through the loosening of those Titanic forces that only Nature can control. The prevention of such cracking means simply the study of the elastic behaviour of the tank wall and the relative compressibility of the earth formation behind it.

4, *Irving Place, New York, Dec.* 15, 1910. HERBERT W. ALRICH.

Relative Effects of Gas and Electric Light on the Purity of Air.

SIR,—I read Mr. Cooper's article in the "JOURNAL" of the 6th inst. with great interest. It would, however, be very valuable to know if tests were made on the temperature of the proposed chamber, so as to determine if a gas-burner would increase the temperature of the chamber without fouling the air therein.

Stockholm, Dec. 30, 1910. G. H. HULTMAN, Engineer.

Analysis of Fire-Bricks.

SIR,—It was with much interest that I read in the "JOURNAL" the paper on "Fire-Bricks," by Mr. Stewart; and no doubt his intention was to do fire-brick manufacturers some good in further impressing on gas engineers the efforts manufacturers are making in order to supply material of a high order.

Unfortunately, Mr. Stewart has, in my opinion, stated the case from a chemical point of view very badly. There is at present a great deal being written by many who have not any practical chemical knowledge in regard to fire-clay, but have only a theoretical insight into the question. No wonder, then, that so much written on the subject is open to criticism.

Any expert reading Mr. Stewart's paper would see that he has not a practical knowledge of chemistry; otherwise he would not have furnished a list of obsolete and careless analyses taken from some periodical perhaps twenty-five years ago, when there was nothing (or very little at least) done as regards research into fire-clays. In the first place, Mr. Stewart's list does not represent the composition of present-day clays. If it is intended to do so, it fails as a means of comparison even, as no mention is made of the percentages of (K_2O, Na_2O) (CaO) MgO, and titanic acid.

It is quite evident that only the silica, alumina, and iron oxides have been estimated, the total of these subtracted from 100, and the result placed under "alkalies, loss, &c." There is also no mention of titanic acid, showing that the figure for alumina is too high. I have never yet seen any of the clays quoted by Mr. Stewart without titanic acid. If Mr. Stewart gets an analysis made of his finest clay, he will possibly find at least 1 per cent. in the calcined sample. I would hardly look on it as a serious impurity, as some of the most refractory clays have nearly 2 per cent. of titanic acid present.

Why should the relationship of silica and alumina be two to one? There are at present retorts having a percentage of silica equal to 53, and alumina 42, which is an ideal composition, as most of the silica is combined with the alumina, leaving very little free silica present. The clay of which these retorts are made belongs to the West of Scotland, and can be worked with no difficulty.

As to the effect of iron oxide in clay, I agree that at times it is a deadly foe. But there are plenty of clays with 5 to 6 per cent. of iron oxide, which have a greater fire stability than many with very little present; the amount of lime, magnesia, and alkalies in both cases not being present in excess.

Dunbreck, Glasgow, Dec. 27, 1910. ARTHUR A. KNOX.

The Water Engineer of Richmond: A Correction.

SIR,—Kindly correct an error published in the "JOURNAL" for Dec. 27 (first column, p. 925) *re* deaths: "Mr. W. G. Peirce, Water Engineer to the Corporation of Richmond." This should read: "Mr. Martin Peirce, Engineer of the Bexhill Water-Works, eldest son of Mr. W. G. Peirce," &c.

Richmond, Surrey, Dec. 29, 1910. WILLIAM G. PEIRCE.

[We much regret the error pointed out by our correspondent, and apologize for it. It occurred in transcribing the notes prepared for the "Review of Water Affairs." The sad event referred to was correctly reported in the "JOURNAL" at the time.—ED. J.G.L.]

Coalite Company and its Concerns.—A letter is to hand from a "Subscriber," who says "I enclose my name, but not for publication." No name and address, however, were enclosed; and consequently the letter cannot appear until these are supplied.

MISCELLANEOUS NEWS.

A "CO-PARTNERS' MAGAZINE" FOR THE GASLIGHT AND COKE COMPANY.

We have received from Mr. Henry Rayner, the Secretary of the Gaslight and Coke Company, the first number of the Company's "Co-Partners' Magazine," which is to be published monthly, price one penny. It has as a frontispiece an excellent portrait of the Governor (Mr. Corbet Woodall), who sends to all the co-partners the following "New Year's Greeting."

Friends,—The appearance of the first number of our "Co-Partners' Magazine" upon the opening day of a New Year gives me a welcome opportunity of greeting you with my best wishes for your health, happiness, and prosperity in the coming time.

Among the many events of my life for which I am grateful, one of the chief is that I have had part in the launching of a scheme which contains so much promise of benefit to our Company and all concerned in it.

It is with the purpose of revealing and helping to realize some of the incidental advantages proceeding from a vast undertaking such as ours, when organized as a co-partnership, that this magazine has been started. Fellowship brings out the inner man; and we wish our co-partners to feel that in this, their own magazine, they have a means of communicating with one another which will help to unite them more closely in the experiences of every-day life under co-partnership.

This principle should awaken a spirit in the ranks of the forces of labour that has been put to sleep by the modern system of joint-stock company enterprise. Under this system, which has enormously increased the productiveness of thrifty peoples' savings, and is one of the strongest points of difference between the past and present business worlds, the old intimate personal relation of employer and employed has in large part disappeared. The most regrettable result of the change is the erroneous impression that the interests of those who pay and those who receive wages are opposed and irreconcilable. This mistaken view of a necessary relationship is of a piece with the equally antiquated idea of the nature of a "bargain," as a transaction in which each party tries to get the better of the other, and one succeeds. Mankind is coming to a better understanding of the nature of trade, as being beneficial to both buyers and sellers. Every man of business agrees now that a bargain which does not benefit both parties is not a bargain at all; and this is as true of the rewarding of labour as of other dealings.

Now it is so that the joint-stock system, which has obliterated the individual master-tradesman, and bereft the industrious apprentice of his hope of reward of the old-fashioned kind, lends itself to an even firmer union of the interest of the employee with those of his remote impersonal employers. Only one journeyman might marry his master's daughter and succeed to the business, but there is no limit to the number of shareholders in a company. All that is necessary is the acquisition of a holding of stock; and in our co-partnery this first step to going into business on his own account is made easy to the employee, and he forthwith takes on the dual responsibility of proprietor and workman, and has the best of reasons for realizing that his interest is one with that of the whole investment.

Co-partnership is a measure of emancipation, of education, and of progress, even if it finds the way to a man's spirit through his pocket. I do not admit this to be a reproach. It is the quality rather than the quantity of one's possessions of various kinds that counts, and a wider outlook over the world and the social system, a feeling of having a stake in the profit of one's own handiwork, a strengthened sense of comradeship in work and play—these seem to me to be among the best boons our co-partnership affords to men of good will; and it is these things that our magazine has been founded to cultivate.

That each succeeding year will see our system more deeply rooted in the confidence of all—contributing increasingly to the general good—is my firm conviction. One other purpose it will serve, in which I rejoice, and that is that it will help to keep alive the memory of Sir George Livesey, who first pointed out its great possibilities.

PAISLEY GAS-WORKS EXTENSIONS.

Progress of the Undertaking.

In connection with some important extensions which have been completed at the Paisley Gas-Works, a visit of inspection by the members of the Town Council was recently arranged, under the guidance of the Engineer and Manager (Mr. George R. Hislop).

The new work, it may be stated, comprises a bench of 80 additional retorts, and an extension of the coal conveying and storing plant in connection therewith. The latter consists of four elevated coal-storage bunkers, each of a capacity of 32 tons, and from which the hoppers on the top of the retort-charging machines are filled. The coal is elevated from the breaking-machines, and tipped into, and carried by, tray-conveyors across the two retort-houses into the elevated bunkers. This addition now gives three lines of such bunkers, of the united capacity of 256 tons—equal to more than 24 hours' requirements. There are two sets of breaking-machines and elevators; and though placed at a considerable distance from each other, by an arrangement of conveyors, the whole of the bunkers can be filled from either breaker and elevator. Electricity is the power employed for operating the machinery for coal-handling and retort-charging, and also for the conveying, screening, or storing of the coke, and for conveying the purifying materials. Two 70 H.P. gas-engines, with suitable generators, supply the necessary current to 28 motors, for the different purposes in the gas manufacturing

process; all these labour-saving devices (introduced in 1906) having effected a decided economy in the cost of production.

After the inspection, an adjournment was made to the Board-room, where tea was provided. Provost Muir M'Kean presided at the outset; but after the preliminaries had been gone through, he vacated the chair in favour of Bailie P. K. Millar, the Gas Convener.

The Provost, before taking his departure, remarked that the gas-works had changed marvellously since he, and most of those present, first knew them. Formerly it was a "one-horse show;" now it seemed they were getting to be one of the most important factories of gas in Scotland. Owing to the enlightened policy of the Town Council for a number of years back, they had got out of the old rut; and they could see that the works were fitted with the newest appliances and machinery, well suited for the work intended. The first suggestion of putting in the new machinery came from parties who complained that the Corporation were working their men in a way they ought not. In consequence, they went to large expenditure in machinery, the result of which was that they had to dispense with labour; and, though it was good that their men were working under more favourable conditions, unfortunately there was this other side to the shield. The profits had been stimulated to some extent, but they knew how difficult it was now to get borrowing powers. They had to have an inquiry before the Sheriff, and then make application to the Scottish Office; and though there were many able men in the Scottish Office, they had very little practical experience of business, and a faint idea of what a manufacturing concern required. They went by rule of thumb. If a Corporation spent £20,000 in turning out 400 million cubic feet of gas, they were not supposed to ask for £20,000 more unless they were turning out 800 million feet—forgetting that, in the case of Paisley, the Town Council succeeded to an old works, and that they had had, independent of the output of gas, to replace and renew almost the whole of the plant and machinery. They were fortunate, however, in having as Engineer Mr. Hislop, who was one of the most capable chemists in the country. They had, also, the great satisfaction of having at the head of their Committee Bailie Millar, who had thrown a great amount of enthusiasm into his work.

Bailie Millar said the work of Convener had been all smooth sailing with him; and this, no doubt, in a great measure, was due to the kind and obliging disposition of their worthy Gas Engineer. They were fortunate in having the services of such an eminent man, whose fame as a skilful and scientific gas engineer was known over all the land, and whose opinion was sought for on many occasions. It was in 1870 that the works became wholly the property of the Town Council. In that year, the production of gas was 86 million cubic feet, the price 3s. 9d. per 1000 cubic feet, and the gross revenue £16,568; whereas this year the production would be 480 million cubic feet, the price 2s. 2d., and the gross revenue £62,158. From 1870 till 1910 the sum of £185,122 had been expended on the works, while during the same period there was handed over for public improvements and to the Electricity Department the sum of £106,758, and for extension of the works, out of profits, £25,047, or, altogether, £131,805. The total borrowing powers, including the £60,000 recently granted them, amounted to £237,842, leaving £52,720 to be spent. The net debt on the works, however, at May last, was only £114,565, while the structural value was £400,000, and the commercial value £550,000. The more recent extensions were in 1905, the coke-conveying plant, workmen's lavatories, and extension of supply to Linwood, costing in all £7338. Then in 1906 coal-conveying and retort-charging machinery was installed at a cost of £8946. In 1907, the sulphate plant was installed; and the extension just now completed would cost about £6300. The introduction of the coal-handling and retort-charging machinery in 1906 had proved a profitable investment since it reduced the number of workmen by forty in midwinter. The Paisley gas undertaking continued to progress and prosper, and would, without doubt, go on doing so under the able and energetic management of their esteemed Gas Engineer, Mr. Hislop. The demand for gas was still on the increase; and, this being so, the extension of the works from time to time became a necessity, though he had asked Mr. Hislop to delay the extension of his coal storage until another year.

GAS IN MANCHESTER.

The following remarks on the gas undertaking of the city are taken from the engineering section of the "Manchester Courier."

On most civic counts Manchester has been highly commended in the past by outside critics. In various directions of municipal government our city is no mean one, taking, indeed, second place to no other city in the United Kingdom. On one matter, however, critics are agreed in abusing us. In the costliness of our gas supply, and a supposed consequent prevalence of smoke in the atmosphere from the use of coal-fires, we are judged and condemned by practically every scientific body in the country. Even the technical journals of the country join in this volume of condemnation, and the usually sober "Engineer" has its fling this week, when it says: "The disregard of the Corporation of the demand of its citizens for an amelioration of its atmospheric surroundings, is little short of amazing. . . . In spite of these deplorable facts, the Corporation insists on putting a ridiculous premium on the price of gas in order that a sum of something like £50,000 may be devoted to the relief of the rates."

Now, it is true—who dare deny it?—that the use of coal-fires results in a pollution of the atmosphere by means of dirt and smoke. It is also true that the Gas Committee pay £50,000 a year to the relief of the rates of the city. Nay, more. It is true that, were gas-fires to supersede coal-fires, the benefit to the city would be almost inestimable. But, having said that, nothing is yet proved against the Corporation.

The ratepayer, not the Corporation, is the man to blame for the present condition of affairs. He it is who insists on payments in relief of the rates. He it is who contends that cheap gas should not be supplied to some citizens at the expense of other citizens who do not use gas at all. He swallows his share of polluted air every day; but he does it gladly—on principle. He knows that respiratory diseases account for hundreds of deaths every year in the city. He knows that Manchester is one of the blackest industrial communities in the country. He knows that the general adoption of gas-fires for coal-fires would help to remove this disgrace. Nevertheless he is obdurate. He would sooner have 3d. off the rates, and take his chance of respiration, than forego the profits paid over by the Gas Committee to the city fund. Indeed, were gas to be sold in the city at 1s. 6d. per 1000 cubic feet, there would still be no guarantee that the citizens, as a whole, would use gas in place of bituminous coal. Hitherto, the private citizen has shown himself to be indifferent to, where he has not actually been ignorant of, the things which minister to his highest welfare, and though one feels chary of defending the Manchester Corporation on any counts—so frail a body is it in a score of respects—one realizes that in this matter the ratepayer alone is the "head and front" of the offending party.

BRITISH COALITE COMPANY, LIMITED.

The General Meeting of this Company was held at Salisbury House, E.C., last Thursday—Sir William H. Preece in the chair.

The Chairman said his confidence in the undertaking was as strong as ever it had been. Important negotiations were in progress, which materially affected the shareholders' interests; and, after giving the matter careful consideration, the Directors had decided that at present it would be inadvisable to make any statement with regard to them. In the ordinary course, they would have postponed calling the shareholders together until a more favourable date; but it was necessary to convene the meeting in order to comply with the provisions of the Companies Clauses Act. He concluded by moving the adjournment of the meeting till the 30th of March next.

Mr. T. Parker seconded the motion.

Mr. Moody asked if any questions were allowed.

The Chairman replied that he could not answer any. He then, at the request of Mr. Moody, read Articles 109 and 110, in which it was stated that at the ordinary general meeting in every year the Board should submit a balance-sheet accompanied by a report from them in reference to the Company's transactions during the period covered by the accounts.

Mr. Moody asked whether the present meeting was one within the meaning of the articles read.

The Solicitor (Sir Frank Crisp) replied that it was.

Mr. Moody contended that the articles had not been complied with, as no accounts had been sent out; and he therefore submitted that the meeting was an "incompetent" one.

There were no further remarks; and the motion was carried with some dissentients.

CHEAP GAS FOR POWER PURPOSES.

Report to the Nelson Corporation Gas Committee.

A few weeks ago, the Gas Engineer and Manager to the Nelson Corporation (Mr. A. Morton Fyffe) was instructed by the Gas Committee to obtain information from other towns as to the charges made for gas supplied for power purposes. The question was raised by an application received from a firm of joiners in one of the out-districts for a reduced rate for gas used by their engine. The prices charged by the Corporation in the borough and surrounding districts range from 2s. 3d. to 3s. 3d. per 1000 cubic feet for ordinary purposes, from 2s. to 3s. for power purposes, and from 2s. and 2s. 6d. for bakers' use. The Corporation pay 1s. per 1000 feet for the gas used at their sewage works; and the millowners in Barrowford are charged at the ordinary Nelson rate of 2s. 3d., if their consumption exceeds 200,000 cubic feet per annum. The average price obtained for the gas sold during the financial year 1909-10 was 2s. 3·18d. per 1000 cubic feet.

Mr. Fyffe at once proceeded to carry out his instructions, and obtained the following particulars as to the net rates per 1000 cubic feet charged in other towns; the figures following the names being the annual make of gas in millions of cubic feet.

Town.	Ordinary Rate.	Power Rate.	Industrial Rate.
Sheffield (3493)	1/4 to 1/-	1/4 to 1/-	1/4 to 1/-
Keighley (343)	1/11	1/9 to 1/3	1/11
Huddersfield (788)	1/11	1/5	1/11
Bradford (2068)	2/- to 1/10	2/- to 1/10	2/- to 1/10
Glasgow (6821)	2/- to 1/9	2/- to 1/6	2/- to 1/6
Halifax (824)	2/- to 1/10	1/9 to 1/7	2/- to 1/10
Oldham (1434)	2/- to 1/8½	2/- to 1/8½	2/- to 1/8½
Leeds (3147)	2/1	1/10	2/1
Warrington (448)	2/1	2/1 to 1/5	2/1
Burnley (672)	2/1½	1/7	2/1½
Dundee (900)	2/1½	1/11 to 1/6	1/11
Birmingham (7327)	2/3 to 1/8	1/8 to 1/5	2/- to 1/5
Manchester (5639)	2/3	1/9	2/3 to 2/-
Nelson (328)	2/3	2/-	2/-
Carlisle (311)	2/3	2/3	2/3
Salford (1656)	2/3 to 1/6	2/3 to 1/6	2/3 to 1/6
Liverpool (4302)	2/5	2/5	2/5
Rochdale (607)	2/6 to 2/3	2/- to 1/6	2/- to 1/6
Southport (535)	2/6	2/4½ to 1/11	2/4½
Wigan (484)	2/7 to 2/3	1/11 to 1/8	1/11 to 1/8
Accrington (426)	2/7½	2/7½ to 2/3	2/7½ to 2/4½
Colne (151)	2/7½	2/7½	2/7½
Edinburgh (2016)	2/8	2/3	2/3
Chorley (140)	2/10 to 2/7	2/3 to 1/9	2/10 to 2/7
Blackburn (714)	2/10½	2/10½ to 2/7½	2/10½ to 2/7½
Padiham (72)	2/11 to 2/9	2/6½	2/11 to 2/9

The following table shows the number of power consumers in the

Nelson gas-supply area, together with the consumption and net income for the year ended September, 1910:—

District.	Number of Consumers.	Ordinary Rate.	Power Rate.	Aggregate Consumption.	Net Income.
				Cubic Feet.	£ s. d.
Nelson—					
Private consumers	36	2/3	2/-	7,214,600	721 9 7
Sewage works . .	1	2/3	1/-	3,581,500	179 1 6
Brierfield, private consumers . . .	12	2/3	2/-	797,700	79 15 6
Barrowford, do. . .	10	2/6	2/3	528,600	59 9 4
Fence, do. . . .	1	3/-	2/3·9	239,900	27 18 1
Blacko, do. . . .	1	3/3	3/-	4,800	0 14 6
Totals . . .	61	..	..	12,367,100	1068 8 6

Having given the quantities of gas used by private consumers in Nelson, Brierfield, and Barrowford, Mr. Fyffe remarks that the primary argument in favour of cheap rates for gas used for power is that this load is obtained almost entirely during the day, and in summer as well as in winter—thus tending to equalize the demand, and make it possible to supply a larger quantity of gas without increasing the standing charges. He points out that the question is also being taken up by many corporations with a view to the abatement of smoke, so that the atmosphere of towns may be purer and healthier. To him, this aspect of the question seems to be of as much importance as any argument on the economic side.

Taken on the basis of the accounts for the financial year ending March 31, 1910, the actual cost of the gas produced in Nelson was 25·09d. per 1000 cubic feet. On the assumption that a day-load could be obtained without increasing the standing charges embraced by the two items "rates and taxes" (2·33d.) and "interest and sinking fund" (9·35d.), the actual cost of the additional gas produced for power purposes would be 13·41d. per 1000 cubic feet.

Mr. Fyffe points out that the question which has to be seriously considered by the Gas Committee is: Can a large day-load, in addition to the present demand, be obtained by offering gas for power purposes at a reduced rate? If not, any reduction made would, he says, only cause decreased revenue to the Gas Department, without any compensating advantages to the Corporation. On the other hand, there are sound reasons for supposing that a power load could be obtained at a lower rate than that at present obtaining; but it would not be in the interest of the Department to decide on a reduction of rate until some substantial evidence is forthcoming that extensive advantage would be taken of the facilities to be offered.

In the district from which the application for a reduction came, the ordinary charge for gas is 3s. per 1000 cubic feet; but in July, 1907, the Gas Committee fixed special rates for the gas-engine of the applying firm, ranging from 2s. 9d. down to 2s. per 1000 cubic feet according to the quarterly consumption of gas. Under this arrangement, their gas bill for the year ended in September last came to £27 18s. 1d., or an average of 2s. 3·9d. per 1000 cubic feet. Mr. Fyffe is of opinion that this figure, when compared with the ordinary rate of 3s. charged in the district, and taking into account the distance from the works, is altogether reasonable. In considering the question of cheap gas for power, local conditions have to be taken into account; and in this connection Mr. Fyffe points out that, owing to the large number of mills and factories using gas for lighting, the present maximum load is during the afternoon, when, of course, engines operated by town's gas would still be running. Against this, however, there is the fact that the lighting of mills and factories only creates a heavy load for five months of the year. For the information of the Committee on this aspect of the question, Mr. Fyffe prepared two diagrams—one showing the weekly consumption of gas for the last financial year, and the other the hourly consumption on Monday, the 5th ult. These are appended to the report.

Mr. Fyffe says the present position is that during December and January the demand for gas in Nelson is such that the producing capacity of the plant is fully taxed; and in the event of a number of new consumers wishing gas for power purposes, there is strong probability that the required quantity could not be supplied. In the last annual report of the Gas Engineer, it was pointed out that the reconstruction of the retort-house would require to be undertaken very soon. Until such time as this is accomplished, Mr. Fyffe thinks it would not be advisable to create an increased use of gas for power, as, even on the present charges, the consumption is steadily increasing, owing to the growth of the town. The statistics submitted regarding the rates in operation in other towns show that the "sliding-scale" method of charges is adopted in the majority of cases; thus indicating the recognition of the principle that the rate should diminish as the consumption augments. The rate for power purposes is almost everywhere less than that charged for ordinary purposes; but in none of the cases given are any restrictions placed on the hours of consumption. In all the circumstances, Mr. Fyffe has no hesitation in recommending that no alteration should be made in the power rates at present, but that the position should be again considered when the producing capacity of the works is increased, as it will be when the retort-house is reconstructed.

CARBURETTED WATER-GAS PLANT AT MANSFIELD.

Inaugural Ceremony.

Members and officials of the Mansfield Town Council visited the gas-works last Wednesday afternoon, in order to witness the formal opening by the Mayor (Alderman T. Taylor) of the new plant which has been installed for the production of carburetted water gas. Owing to the growing demand for gas, it became necessary to increase the output; and after a deputation had visited various towns they unanimously recommended the manufacture of water gas; and this was agreed to by the Council. A loan for £6500 was sanctioned by the Local Government Board, and the contract for the erection of the plant let to Messrs. Humphreys and Glasgow, who expeditiously carried out the work. The Chairman of the Gas Committee (Mr. T. Smith) has taken the greatest interest in the progress of the scheme; and it was on his invitation, and that of the other members of the Committee, that the Council assembled on Wednesday to inspect the plant, which was done under the guidance of the Gas and Water Engineer to the Corporation (Mr. Arthur Graham). At the close of the inspection, the works were formally declared open, though, as a matter of fact, they have been in operation for a month. A few speeches were made. Mr. Smith stated that the contracts came to £6335, or £165 less than the amount sanctioned. He thought this spoke volumes for their Engineer, of whose capabilities he said he was very proud. Mr. Graham had done his work well; and of the Contractors he could not speak too highly. The Mayor expressed the opinion that the new plant would prove to be one of the best, financially and otherwise, they had ever had in Mansfield. Votes of thanks were accorded to the Mayor and Mr. Smith; the latter and the Engineer being congratulated on the satisfactory condition of the plant at the gas-works.

RETFORD GAS AND WATER SUPPLY.

Cheaper Gas for Power—Abolition of Bath Water Charges.

At the Meeting of the Retford Town Council last Friday, the Gas Committee brought forward a recommendation that, as from the beginning of the year, the gas supplied for motive power should be subject to a discount of 25 per cent.—making the net charge 1s. 9d. per 1000 cubic feet—provided it is passed through a separate meter. The object is to encourage the use of gas for motive power, and induce the owners of industrial concerns to go to the town, which possesses many advantages as a manufacturing centre. At the same meeting, the Water Committee brought up recommendations that in future all new water services or renewals should be laid free of cost up to 30 feet, including the provision of a stop-tap and box; and that the charges for baths should be abolished—the rates for domestic supply to include water for baths. The recommendations were unanimously adopted; and the Gas and Water Committees, as well as the Gas Engineer and Manager (Mr. J. B. Fenwick) were congratulated.

ST. DAVID'S WATER AND GAS COMPANY.

At the Ordinary General Meeting of this Company recently held, the Directors submitted a report for the year to the 30th of June, which was accompanied by a balance-sheet (not certified by the Auditors), and a statement of accounts. While regretting that the accounts did not show the growth that had been anticipated, the Directors said they were pleased to be able to report that, since the period covered, an extension of the supply to the County Schools had been completed, and several applications had been made for slot installations; so that it might reasonably be expected that the accounts for the current year would show an improvement. In August last, at the instance of a debenture-holder, a Receiver was appointed; and the Directors felt bound to point out that the whole undertaking was liable to be sold to discharge the debenture debt. If this should take place, it was impossible that a forced sale could realize anything for the shareholders. Under these circumstances, the Directors would welcome the election to the Board of two or three of the larger shareholders, to assist them in dealing with the difficult position. At the same time, they advised the shareholders to avoid being influenced by persons who had no financial interest in the Company, and whose interference had, they said, frequently resulted in disaster to the shareholders. The balance-sheet had been prepared by the Secretary, Mr. E. C. Saphin. For the following account of what took place at the meeting we are indebted to the report in the "Financial News."

At the outset, the shareholders were informed by the Secretary that the Directors had resigned in a body, and that none of them were present. It was therefore decided that Mr. H. A. Godson Bohn should preside. On taking the chair, Mr. Bohn said that at a previous meeting he had called for the minutes; but they were not produced—the Secretary saying they were at home. The next thing he had asked for was the Engineer's report; but this was not produced. It was then suggested that the accounts should be prepared for putting before the shareholders; but this had not been done. It only remained for the meeting to appoint a new Board and a new Secretary. The report did not fully set forth the position of the Company. There was no Auditors' certificate. He thought that the only thing left for the meeting was to appoint a new Board. He therefore proposed that the Board of Directors be removed; and this was carried. The question of the secretaryship was left to the new directorate.

A new Board was then appointed, consisting of Messrs. H. A. Godson Bohn, A. Evans, and Morton F. Cadman, together with the Rev. E. Rivers. It was resolved that the report and accounts, as produced by the old Board, be received; but this was not adopted.

In answer to questions, the Secretary said he considered the movement for his removal quite illegal, and he should assert his rights. He did not know in whose possession the original contracts were, as the Company had been working for two years before his appointment. With regard to the issue of debentures and shares, he was unable to say where the agreement was relating to this matter, and he could not tell who prepared it. He did not know who was the Solicitor of the Company; and, moreover, he was sure the meeting would not be able to get any information from him. He declined to answer any questions with regard to the drawing-up of the contracts, and refused to allow access to any documents relating to any of the business of the Company. He said these were all in a box, and would be handed over to his successor when his own three months' notice expired. He would not entertain the idea of an appointment by the new Board to see the contents of the box, as it would be most inconvenient to him.

GASEOUS FUEL AND PURER AIR.

"The Times" last Tuesday contained an interesting article on "A Purified London Air." The following extracts from it bear upon the use of gaseous fuel as a valuable auxiliary in the efforts made of late years to obtain relief from smoke and fogs.

The decrease in recent years, not only in the frequency but in the intensity of London fog, is a matter which admits of no serious question. Persons who have reached middle age well remember the time when dense smoke-fogs of the worst possible description were a common feature of the winter season, and lasted not infrequently for a week or more at a stretch. Nowadays the visitation is rare, and in its aggravated form seldom continues without intermission for more than two or three days. . . . Taking a series of twenty-seven winters, and dividing them into three periods of nine years each, we arrive at the following very striking result :—

	Days with Fog.	Hours of Bright Sunshine.
First nine winters—1883-4 to 1891-2 . . .	29·9	.. 55·6
Second nine winters—1892 3 to 1900-1 . . .	20·7	.. 70·1
Third nine winters—1901-2 to 1909-10 . . .	10·6	.. 93·5

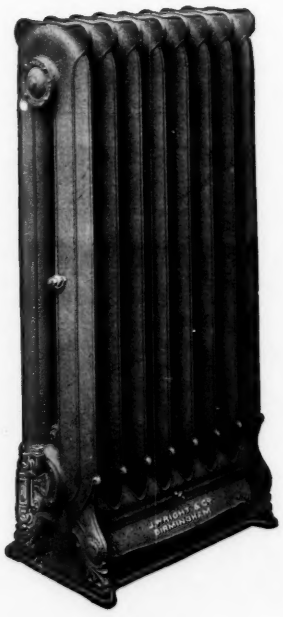
In the course of a discussion on the subject which took place six years ago at a meeting of the Royal Meteorological Society, various opinions were expressed as to the causes which had led to so marked an improvement in the air of London. According to one authority, the change was due to an increase in the strength of the wind in recent years, as shown by the anemometrical records made at Greenwich ; another speaker attributed it to an increased dryness of the London atmosphere, owing to the large and increasing area covered by paved streets and slated roofs ; and yet another, to the widely extended mass of air actually warmed above the outside temperature by fires and their products, as well as by contact and radiation from comparatively warm walls and roofs. Far greater weight may in all probability be attached to the views of speakers who suggested that the increased purity of the atmosphere was due to the efforts made within recent years by our municipal reformers (the term is used in its widest, and not in any political, sense) towards a diminution of the smoke evil. . . . The diminution of smoke which has taken place within recent years may be attributed in large measure to a more vigorous enforcement of the smoke-prevention clauses of the Public Health Act ; but it has in all probability been materially aided by the increased use of gas-fires for both heating and cooking purposes, and also by improved methods of lighting. The geographical situation of London, on the banks of a large river, is undoubtedly favourable for the development of fog and mist ; but with the cleaner air we now enjoy, it seems unlikely that in the future the dreaded visitation will reappear in anything like the degree of severity it assumed twenty or thirty years ago.

NITRATE OF SODA MARKET LAST YEAR.

In the report on the market for nitrate of soda issued by Messrs. W. Montgomery and Co., Limited, this time last year, they foreshadowed a large consumption of this fertilizer during 1910. But in the repor just to hand they say that neither they nor anyone else expected so magnificent an increase as that which they have to record. In 1909, there was a rise of 196,000 tons, or 11⅓ per cent., on the consumption in 1908 ; whereas in 1910 there was a further advance of 302,000 tons, or 15½ per cent. The exact figures are 2,250,000 tons in 1910, against 1,938,000 tons in 1909. The first-named total was apportioned as follows: Continent of Europe, 1,531,000 tons ; United States, 510,000 tons ; United Kingdom, 120,000 tons ; other countries, 89,000 tons. Compared with the preceding year, there are increases respectively of 13, 25¾, 8, and 35 per cent. Messrs. Montgomery remark that a few people, who are staggered by the magnitude of the consumption last year, have questioned whether it would be maintained in the current twelve months. But they consider that no sound reasons can be adduced for any such doubt. They think the need for nitrogen in the coming season will be very great, for the reason that the heavy and continuous rains of the past two months must have washed out any reserve which may have been left in the soil from last season. The course of prices during the past six months was consistently upward—from 8s. 1d. per cwt., cost and freight, to 8s. 7½d. What it may be during the coming twelve months cannot be predicted until the consumption demand has asserted itself ; but Messrs. Montgomery say that should it be on the lines of the year just closed, and assuming a production limit of 55 million quintals per annum, an improvement must be looked for. If there should be even a slightly increased demand, they think it would not be unreasonable to expect a material improvement. The margin between production and consumption is now narrowed down to about 3 million quintals, or (say) 150,000 tons, in favour of production ; so that, should the European demand remain stationary, many months cannot pass before the requirements of America and other countries will make consumption and production run on parallel lines. When this is the case, keen competition between Europe and America to obtain the production may be expected. The European stock of nitrate is now 310,000 tons, compared with 337,000 tons twelve months ago ; while the quantity afloat is 659,000 tons, against 672,000 tons. The visible supply for Europe is 969,000 tons, against 1,009,000 tons. The total consumption of the world during the past three years has been : 1908, 1,732,000 tons ; 1909, 1,938,000 tons ; 1910, 2,250,000 tons. The shipments for the same period have been : 1908, 2,017,000 tons ; 1909, 2,100,000 tons ; 1910, 2,285,000 tons.

The Directors of the Shotley Bridge and Consett District Gas Company have decided to allow a discount of 5 per cent. to ordinary consumers off the quarterly gas accounts, if paid promptly.

The Automatic Valve Indispensable



Without an Automatic Valve, the fullest economy of gas is absolutely impossible in any type of Radiator. You are burning a fixed quantity of gas whether you need it or not; if it is correct at one temperature, then obviously it will be too much when the temperature is considerably higher, and too little when lower.

With the Automatic Valve of the "ST. ANDREW," you burn exactly the amount of gas required at any particular state of the temperature—no more and no less.

The "ST. ANDREW" Automatic Valve is an essential guarantee of perfect Gas economy.

JOHN WRIGHT & CO.,
The Radiator Experts,
Essex Works, BIRMINGHAM.

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NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

In connection with the Kirkcaldy gas transfer, a conference was held in London on Wednesday of this week between the Oversman, Arbiters, and Solicitors of the Corporation and the Gas Company. Bailie J. Wright, the Convener of the Gas Committee, was also present. It was resolved that the arbitration proceedings should take place before Lord Shaw of Dunfermline in the North British Station Hotel, Edinburgh, commencing on Jan. 9. The Company have lodged alternative claims of £200,000 and £224,000.

At the end of last week, the Paisley Town Council, in a formal way, inaugurated an addition to the carbonizing capacity of the gas-works. An extension of the retort-house has been built, in which there is provision for 80 retorts; bringing the total number in the works up to 416. The increase is equal to 26·31 per cent., and provides a reserve of 36·84 per cent. The intention is that by the time this reserve is reduced to the limit of safety, a carburetted water-gas plant will be introduced, which will be equal to another 100 retorts. Four coal-bunkers, each of 32 tons capacity, with gravity bucket conveyors, have been erected—two in connection with the new retort-bench, and two in connection with a bench erected in 1899. The erection of the new retort-house had the effect of curtailing the space for coal storage by about 1200 tons; and new stores are being built, which will give accommodation for 3300 tons, and will raise the total storage capacity to 9500 tons—equal to 41 days' supply, on the basis of last year's requirements. An account of the inspection appears on p. 48.

The Gas Provisional Order for Dundee, recently carried through, cost £427; and at a meeting of the Gas Committee on Tuesday, a remark was made about the smallness of the amount. The Town Clerk said that the sum did not include any charge for the work of his department. He respectfully suggested that a sum should be added to the total, and credited to the Town Clerk's fee fund. This would have the effect of increasing the cost slightly to a profit-earning concern, and of lessening the rates. He suggested £100; and this was agreed to. Treasurer Soutar said that previous Provisional Orders had cost a good deal because of objections taken by permanent Government officials; and but for the clear arguments submitted on this occasion by their officials—the Gas Engineer and the Gas Treasurer—he questioned if the application would not have been sent back. At one time it looked very much as if the Order would be treated in this way; and it was not the simple affair that it looked. The question had reference to the shortening of the sinking-fund period.

Some time ago, the subject was raised in the Dysart Town Council of charging the Gas Company wayleave for their pipes in the streets of the burgh. There was a good deal of discussion and correspondence upon the matter, in the course of which the Company suggested the holding of a conference with the Town Council. At the conference, the Council asked for a discount upon the public lighting account to the amount of 15 per cent. The Company offered to give 10 per cent.; and a compromise was effected at 12½ per cent.

At a meeting of the Corporation of Greenock on Thursday, Provost M'Millan moved that they accept the offer of Mr. John M'Ewan, of Greenock, to erect four new purifiers in the Corporation gas-works at Inchgreen, at a cost of £8739. Bailie Taylor, the Convener of the Gas Committee, seconded, and mentioned that the offier was £500 below the next highest. The motion was unanimously adopted.

Mr. G. Baxter, the Water Engineer to the Corporation of Dundee, has prepared a report on the subject of the afforestation of the catchment area from which the water supply of the city is derived. He is altogether in favour of the growth of trees in catchment areas; but in consideration of the fact that the monetary benefits to be derived by the present generation would be practically *nil*, he considers it would be unfair to burden it with the cost even of the maintenance of such a scheme. To plant the 500 acres at Crombie he estimates would cost £3250. If this sum were placed to capital account, the annual charge out of revenue for interest and sinking fund would be £146; and the loss of rent would amount to £349; making a total annual charge of £495. He thinks it would not be prudent to charge work of this character, when executed in a piecemeal fashion over small areas, to capital account. It would be unremunerative for at least a generation, and, even although posterity should reap the whole profit, he believes that such highly-speculative operations should be met right away out of revenue. The question of the afforestation of the 19,000 acres at Lintrathen Mr. Baxter thinks should be dealt with only by an expert in forestry. The land should be gradually afforested by the Commissioners' own men; the cost to be defrayed out of revenue.

CURRENT SALES OF GAS PRODUCTS.

[For Table of "Tar Products Prices," see p. 56.]

LIVERPOOL, *Dec.* 31.

Sulphate of Ammonia.

Notwithstanding the intervention of the holidays, the strength of the market has been well maintained throughout the week, and a further advance in prices has to be recorded; the quotations at the close being £12 16s. 3d. per ton f.o.b. Hull, £12 17s. 6d. per ton f.o.b. Liverpool, and £13 per ton f.o.b. Leith. A large amount of the demand has been for covering former contracts, especially those made with United States buyers some months ago, but direct consumers have also been more in evidence. Manufacturers are now quoting £13 per ton f.o.b. at the best ports for delivery over the first half of 1911, and £12 15s. per ton over the second half; while it is reported that £13 has actually been paid for January-March shipment.

Nitrate of Soda.

The position of this article continues very firm, but holders are still willing to accept 9s. 6d. and 9s. 9d. per cwt. for ordinary and refined qualities respectively, on spot.

THE "DARWEN" ARCH PIPE

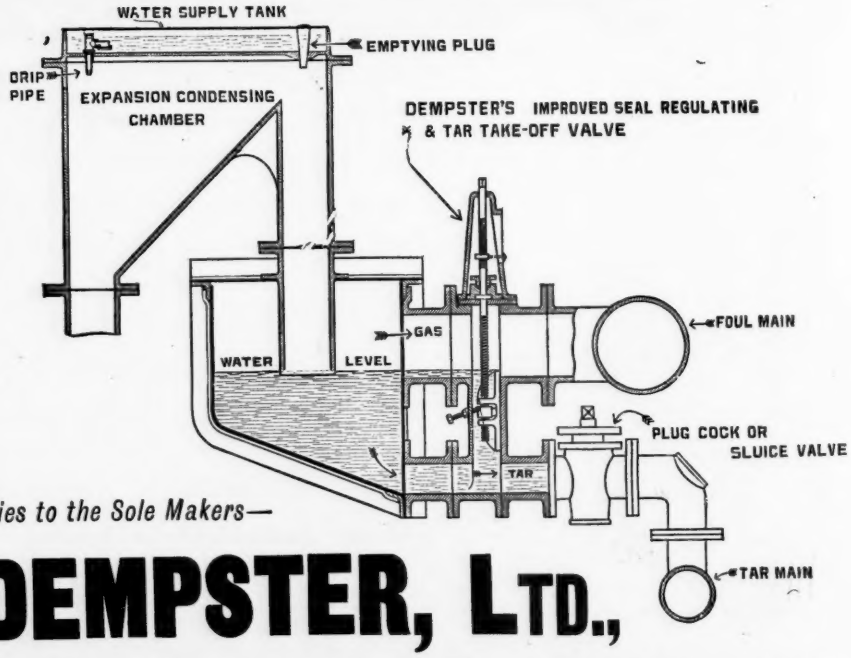
Prevents Stopped Ascension Pipes.

"The Cost is moderate and can be saved in a Single Season."

"The Arch Pipes can be seen in operation upon application."

"It will pay you to try them upon troublesome Pipes."

Upwards of 400 are already at Work or on Order.



Please address all Enquiries to the Sole Makers—

R. & J. DEMPSTER, LTD.,

GAS PLANT WORKS, MANCHESTER.

LONDON, *Jan.* 2.

Tar Products.

The market for tar products has been very steady during the past week. Pitch maintains its price, and better figures are expected. Creosote is steady, though there is not a large amount of business doing. It is very difficult to do business in crude carbolic acid owing to the wide margin of difference in the ideas of consumers and manufacturers. Benzols are firm. Solvent naphtha is not of very great interest for prompt delivery.

The average values during the week were: Tar, 17s. 6d. to 21s. 6d., *ex* works. Pitch, London, 35s. 6d. to 36s.; east coast, 35s. to 35s. 6d.; west coast, Clyde, 34s. 6d. to 35s. 6d., Manchester, 34s. to 35s., Liverpool, 34s. 6d. to 35s. 6d. Benzol, 90 per cent., casks included, London, 8½d. to 8¾d.; North, 7¾d. to 8¼d.; 50-90 per cent., casks included, London, 8¼d. to 8½d.; North, 8d. to 8¼d. Toluol, casks included, London, 9½d.; North, 9d. Crude naphtha, in bulk, London, 3¾d. to 4¼d.; North, 3d. to 3¼d.; solvent naphtha, casks included, London, 11½d. to 1s.; North, 10½d. to 11d.; heavy naphtha, casks included, London, 11¾d. to 1s.; North, 11d. to 1s. Creosote, in bulk, London, 2 5/16d. to 2 7/16d.; North, 1⅞d. to 2d. Heavy oils, in bulk, 2¾d. Carbolic acid, 60 per cent., casks included, east coast, 1s. 1½d.; west coast, 1s. 1d. Naphthalene, £4 10s. to £8 10s.; salts, 40s. to 45s., bags included. Anthracene, "A" quality, 1½d. to 1¾d. per unit, packages included and delivered.

Sulphate of Ammonia.

The market for this article has been very steady, and in some quarters improved prices have been paid. Actual Beckton is now quoted for forward delivery at £12 7s. 6d. to £12 10s. Outside London makes upon Beckton terms are £12 5s. to £12 6s. 3d.; Hull, £12 17s. 6d. to £13; and Liverpool, £12 17s. 6d. In Leith, the majority of makes seem to be sold for near delivery, and makers are quoting £13 for spring shipment. In Middlesbrough, £12 17s. 6d. to £13 is asked.

Gas Companies and the Hulton Colliery Disaster.—The Directors of the Westhoughton Gas Company have contributed £50 to the Mayor of Bolton's fund in aid of the sufferers by the disastrous explosion at the Hulton Colliery Company's pit at Atherton. A similar sum has been given by the Littleborough Gas Company.

Gas-Tube Trade.—According to the Engineering Supplement to "The Times," some inquiries are in progress with the object of ascertaining whether anything can be done to revive the combination in the gas-tube trade which was abandoned two years ago. Business has been unsettled of late by the excessive discounts made. It is suggested that if the association is to be re-established an impartial examination of the books of manufacturers over an agreed period should be first made, so as to fix a common basis, and that a heavier penalty than formerly existed should be provided.

COAL TRADE REPORTS.

Northern Coal Trade.

The coal trade of the north-east has had the lessened output which is the result of the holidays. Thus there has been a reduced shipment, and prices that have been almost nominal—the transactions being very few. In the steam coal trade, best Northumbrians are from 9s. 6d. to 9s. 9d. per ton f.o.b., with a rather limited business; while second-class steams are from 8s. 3d. to 8s. 6d. For steam smalls, the prices quoted have been from 5s. to 6s. 6d. per ton. In the course of a few days, it is hoped that there will again be a normal output. The gas coal trade has been also interfered with as far as the production is concerned, and consequently the deliveries on the long contracts have been moderate. Durham gas coals appear to be steadier in price. Second-class kinds are from 8s. 6d. per ton f.o.b.; while for best Durhams, the quotation is firmer at from 9s. 3d. to 9s. 4½d. "Wear" specials are from 10s. 3d. to 10s. 6d. In the coke trade, the price is firm. The large output of gas coke seems to be well taken up; the price for good quality being from 14s. 3d. to 14s. 6d. per ton f.o.b.

Scotch Coal Trade.

As is usual at this season, trade is quiet; the only sorts in demand being ell and splint for shipment. Small stuffs are finding a ready sale now that the boilermakers are again at work. The prices now quoted are: Ell, 9s. 9d. to 10s. 3d. per ton f.o.b. Glasgow; splint, 10s. 6d. to 10s. 9d.; and steam, 9s. to 9s. 3d. The shipments for the week amounted to 329,153 tons—an increase of 2569 tons upon the preceding week, and of 10,334 tons upon the corresponding week. Down to the 24th ult., the total shipments during 1910 amounted to 15,937,777 tons—an increase of 761,352 tons over the corresponding period of 1909.

Reproductive Undertakings in Germany.—According to some figures given in a recent number of the "Municipal Journal," out of the 50 largest towns in England and Germany, 21 in the former country own the gas undertakings, as compared with 50 in the latter; 44 own the electricity supply, compared with 42; and 39 own the water supply, against 48.

Bursting of a Water-Main.—On the evening of Saturday, the 24th ult., a high-pressure water-main, 48 inches diameter, which conveys water from the works of the Metropolitan Water Board at Long Ditton to the southern district of London, burst at a spot about half-way up Kingston Hill. The force of the water was so great that large paving-stones were hurled a considerable distance, and part of the adjacent tramway track was torn up. An immense volume of water swept down the steep hill with great force. The burst occurred at the busiest period of the evening. The effect of the accident was to stop the Kingston Hill tram-cars, and all traffic had to be diverted for some hours. The Board's breakdown gang was summoned, and worked all night and all Sunday in repairing the damaged main.

A REMINDER!

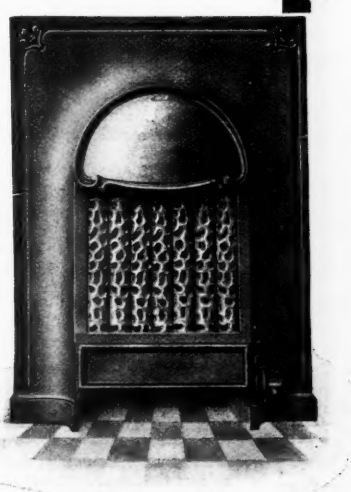
"As the Day Lengthens, the Cold Strengthens."

SO RUNS AN OLD SAW.

This being so, the demand for Gas Fires will increase.

The ideal Gas Fires for Hiring purposes are those in MAINS'

"D.S.O." Series.



Unequalled for Strength and Simplicity.
Parts reduced to a Minimum.
Consequently Maintenance a Negligible Quantity.

R. & A. MAIN, LIMITED,

WORKS: Gothic Works, EDMONTON, N.; and Gothic Ironworks, FALKIRK.
SHOW-ROOMS: 25, Princes Street, Oxford Circus, W.; 136, Renfield Street, GLASGOW;
56, Broad Street, BIRMINGHAM; 83, Old Market Street, BRISTOL; and 13, Whitworth Street West, MANCHESTER.

Diaries, Calendars, &c.

We have received diaries, calendars, complimentary cards, &c., from (among others) the following :

Bale and Church, 5, Crooked Lane, E.C.
Chichester Gas Company, per Mr. T. E. Pye.
Clark's Lead and Colour Works Company, Reading.
G. J. Eveson Coal and Coke Company, Limited, Birmingham.
Gas-Meter Company, Limited, 238, Kingsland Road, N.E.
A. C. Scrivener (Wigan Coal and Iron Company), 6, Corporation Street, Birmingham.
Simon-Carvès Limited, 20, Mount Street, Manchester.
Andrew Stephenson, Palmerston House, Old Broad Street, E.C.
F. C. Sugden and Co., 28, East Parade, Leeds.
Joseph Taylor and Co., Central Plumbing Works, Bolton, Lancs.

Falsification Charge at Bradford.

Last Thursday, at Bradford, William Peel (27), a clerk, formerly in the employ of the Bradford Corporation, was committed for trial on a charge of falsification of a receipt-book for rates and water. It was stated that prisoner was employed as clerk and collector. It was his duty to attend the counter to receive sums of money and cheques in payment of accounts, and to receive cheques that had come through the post. A sum which the prosecution alleged to amount to £1704 was in question. The prosecution suggested that the money had been embezzled by the prisoner, and that he had covered his tracks by an intricate and practically efficient system of issuing bogus receipts and making bogus counterfoils. The prisoner was employed by the Bradford Overseers from 1901 until April, 1907, when the Corporation took over the Overseers' work, and Peel was then under the charge of the City Treasurer. Following his arrest, he made an admission to Mr. Whiteley, the Assistant City Treasurer, that the defalcations had been going on for some years, and commenced prior to the date when the work was taken over by the Corporation. The system of receipts employed by the Corporation made it practically impossible for a mistake to be made unless wilfully and deliberately done. A carbon counterfoil should be an exact copy of the receipt issued. Prisoner pleaded "Not guilty," and reserved his defence.

Acetylene Plant in Mexico.—According to a report made by one of the United States Consuls, the increasing use of acetylene gas in Mexico is due to the high rate charged for electric light in cities where lighting is practically a monopoly ; and he calls for attention to the Mexican markets. Agents for calcium carbide in Guadalajara have decided on a machine made in Chicago as giving the best results for the lowest expenditure ; and a number of these plants have been installed in stores and clubs. A Company has recently been formed to manufacture calcium carbide, which is being sold in Mexico City at $5·98 per 110 lbs. It is thought that there should be a demand for acetylene lighting in the isolated villages throughout Mexico, and also in the stores and warehouses in the cities, provided the carbide can be delivered at a more reasonable price.

Road Tarring at Wrexham.—As the result of the presentation of the report of the General Purposes Committee of the Wrexham Corporation, some questions were put to the Borough Surveyor, at the meeting of the Town Council last Wednesday, on the subject of the tarring of roads. The questioner was Mr. Taylor, who said certain roads which had been treated with tar were like a ploughed field ; and he asked the Surveyor if he considered tar paving was a success. The official named replied that he did, as it not only laid the dust but acted as a binding material. Considering the weather and the driving of traction-engines over the roads, they were in very fair condition. Alderman Samuel said that to state that tarring roads was not a success was absurd. Surveyors all over the country favoured it ; and the cost was very small. After some further remarks, the subject dropped, on the understanding that the Surveyor will reply to Mr. Taylor at the next meeting of the Council.

Birkenhead Water Scheme.—At to-morrow's meeting of the Birkenhead Town Council, several matters will be considered relating to the water scheme. Among questions which have been occupying the attention of the Water Committee is that of the proposed Alwen reservoir. They have approved a recommendation of a Special Sub-Committee that the tender of Messrs. Robert M'Alpine and Sons be accepted for carrying out the works in connection with the removal of peat from the site, and the construction of the reservoir and masonry dam, embankments, &c., in accordance with the Engineers' specifications, for the sum of £186,153 15s. 3d., subject to a contract already approved, and subject also to a guarantee of £20,000 for the due performance of the contract. They also approved a recommendation that Mr. J. H. Parkin, Assoc.M.Inst.C.E., who is at present engaged on preliminary works in connection with the construction of the reservoir, be appointed Resident Engineer, at a salary of £500 per annum, with house accommodation.

Complaint about Gas-Works Smells.—A memorial was presented to the Plympton Rural District Council last Friday, from the inhabitants of Underwood, which is near the Plympton Gas Company's works, complaining of "the harm and disadvantage caused to the district by the noxious and extremely unpleasant smells" emanating from the works. "This nuisance," the memorialists added, "is caused, we understand, by the fact that a commodity other than coal gas is manufactured, the fumes from which are extremely harmful to health." Dr. Noy Scott, the Medical Officer of Health for the district, remarked that at times the fumes were, no doubt, unpleasant ; but he thought it almost impossible to prove that they were injurious to health. The gas-works were under regular inspection by a Government official, who was satisfied that the usual and proper precautions were being taken. A copy of the memorial should be sent to him. If the Clerk to the Council would take action, he would support him ; but he should be surprised if anyone could prove injury to health. The matter was referred to a Committee.

THE CANNON "TORRID"

Gas Heated Radiator.

Fitted with Luminous Burners.

With Trivet Door at Front and Back, and Copper Reflectors.

Pure Heated Air.

FACTS as proved by Scientific Test :—

NO FLAME CONTACT WITH COLD SURFACES, securing Perfect Combustion.
NO FUMES—NO FLUE REQUIRED.
NO EXPOSURE OF FLAME.
NO CONDENSATION IN TUBES, and therefore
NO CORROSION OF TUBES.

Ask for our "Congenial Warmth" Booklet containing full report of this Test, carried out by a well-known Gas Engineer.

MANUFACTURERS :—

CANNON IRON FOUNDRIES, LD.,

DEEPFIELDS, Nr. Bilston, Staffs., Eng.

London Show-Rooms :—

18, HOLBORN VIADUCT, E.C.

Australasian Agents :—

JAMES HURLL & CO., Ltd., 20, Loftus St., SYDNEY

Reduction in Price at Guildford.—The Directors of the Guildford Gas Company intimate a reduction, as from the 31st ult., of 2d. per 1000 cubic feet in the price of gas supplied for domestic purposes and for gas-engines. The reduction will also apply to all consumers by prepayment meters within a distance of two miles from the works.

Reduction in Price at Bangor (Co. Down).—The Bangor (Co. Down) Urban District Council have, on the recommendation of the Gas Committee, resolved that, as from the beginning of the financial year, the price of gas be reduced from 3s. 6d. to 3s. 3d. per 1000 cubic feet, and that 10 per cent. reduction be given to those consumers whose yearly accounts amount to £50 or over. Where a person has both business premises and a private residence, however, the two accounts for gas consumed will not be amalgamated for the purpose of bringing the total consumption to an equivalent of £50.

Salford Gas Charges.—The *agenda* for to-morrow's meeting of the Salford Town Council contains a long resolution in the name of Mr. Purcell, one of the Labour members, regarding the gas charges. It asks that the Gas and Finance Committees shall prepare a statement giving particulars of the number of houses upon which rates are paid direct and indirect by the occupier, and their rateable value; the number of slot and ordinary meters under each head; and the total amount paid by the gas undertaking to the borough fund, the district fund as "annuity," and the district fund account, in each case since the first payment.

Power Gas Corporation, Limited.—The Directors report for the year ended Sept. 30 last that the results of the year's trading of Messrs. Ashmore, Benson, Pease, and Co. show a total profit of £5878, to which has been added the balance of £3174 brought from the previous accounts; making altogether £9052. Of this sum, £2700 has been transferred to reserve, £4000 to the accounts of the Power Gas Corporation for dividend, and the balance (£2352) carried forward to the next account. The results of the year's trading of the Corporation show a total profit of £8016, to which has been added £5690 brought forward; making altogether £13,706. This the Directors propose to apply as follows: To the reserve fund, £1600; to dividend at 4 per cent. per annum upon the ordinary shares, to be paid less income-tax, £9984; balance to be carried forward to next account, £2122.

Reduction in Price at Bodmin.—The Directors of the Bodmin Gas Company have reduced the price of gas for lighting purposes from 4s. 2d. to 3s. 9d. per 1000 cubic feet, subject to discount for prompt payment varying with the quarterly consumption. The gross price of gas used for cooking, heating, and motive power will remain as before, but will be subject to discount. The net prices obtainable will range from 3s. 7d. and 3s. 1d. down to 3s. 4d. and 2s. 10d. The old net prices were 3s. 8d. and 3s. 7d. for lighting, 3s. 3d. for cooking and heating, and 3s. 3d. and 3s. for motive power. In the case of prepayment meters, rebates ranging from 6d. to 9d. per 1000 cubic feet, according to consumption, will be allowed at the quarterly collections, in all cases where the Company's property is kept clean, and everything is in order. The net prices of gas, with use of cooker and one bracket, will now range from 4s. 2d. down to 3s. 11d. per 1000 cubic feet.

The Lighting of Longwood.—In a letter to the local Press on the subject of the recent meeting of Longwood ratepayers with reference to the lighting question and the price of gas, Mr. Robert Thornton (the Chairman of the Longwood Gas Company) points out that the Company were no party to the promise made by the Huddersfield Corporation, when they induced Longwood to be included in the borough, that the same price should be charged for gas as by the Corporation; and he considers it grossly unfair to attempt to throw the liability for such a promise on to the Gas Company. "It is," he says, "impossible for such a comparatively small works to produce gas as cheaply as a large Corporation like Huddersfield. The history of the Gas Company is a very varied and hard one, against almost continuous and varied opposition; and this notwithstanding, I challenge the promoters and those who took part in the Longwood meeting to name more than two or three other districts of similar population and extent in Yorkshire that have been, and are being, so well served. As a Company, we shall continue to do our utmost to serve our district as well and as cheaply as possible. If the consumers will study their own interests, they will continue to use gas. Knowing the relative value, the Company do not fear the result of competition with electricity, based upon its own merits."

Mr. Richard Hoyle has retired (as from the end of 1910) from the firm of Richard Hoyle and Co., of Newcastle-upon-Tyne; and the remaining partner, Mr. Philip S. Wood, will continue the business in partnership with Mr. John Fairweather, as "Wood and Fairweather," at the same address.

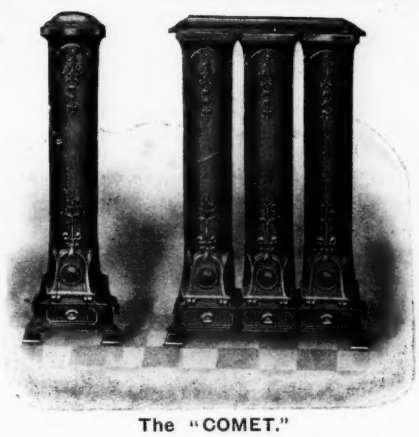
John Goodworth, a Leeds draper and grocer, was, a local paper reports, badly burned, "while carrying out some experiments in the making of gas." The members of the fire brigade, who were summoned, rendered first aid; and afterwards the sufferer was taken to the infirmary, where he was detained.

Henry Gee, a Leek publican, was found dead in bed on Boxing-day; and at the inquest a verdict of "Accidental death" was returned. His son said that at about midnight on the Sunday he went into the room and turned the gas nearly out; but next morning when he was summoned to the room, the tap was right on and the place was full of gas.

Students of the Hornsey Gas Company's class in "Gas Supply" recently visited Messrs. Parkinson and Cowan's meter works in Cottage Lane, City Road. Mr. Parkinson personally conducted the party through the various shops, where, among other things, they were shown a high-pressure compensating meter and a large station meter in course of construction for a works abroad. The visitors were also shown the various parts of an automatic meter before being assembled. One thing remarked on was the orderly and clean way in which the shops were kept. After the inspection, the students were entertained at tea. Mr. Thomas Holgate, the lecturer to the class, in thanking the firm, remarked that the students were indebted to Mr. J. W. Buckley, the Engineer and Manager of the Hornsey Gas Company, for allowing them enough time so that they might accept the kind invitation to inspect these very interesting works.

RADIATORS

for all requirements.



The "COMET."

A Luminous Flame Radiator, built on the sectional principle.

Supplied in various Finishes.

PARKINSON

THE WELL-KNOWN

GAS-HEATED STEAM RADIATOR

(SINGLE OR DOUBLE COLUMN).

Supplied with Flue Connection when required.

THE

PARKINSON STOVE CO., LTD.

(Incorporating Maughan's Patent Geyser Co.),

BIRMINGHAM & LONDON.

The Richmond Gas Stove and Meter Company, Limited, have received an order for 52 of their "Monarch" gas-steam radiators, which are to be installed in a large block of residential flats in the West-end of London.

Alfred Williams and Co., Limited, has just been formed with a capital of £1200, in £1 shares, to carry on the business of coal, coke, and iron merchants recently acquired by Mr. P. W. Quartermass at 71, Bankside, S.E.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.

CHIEF DISTRIBUTING ENGINEER. Oriental Gas Company. Applications by Jan. 9.
DRAUGHTSMAN. No. 5338.
WORKS FOREMAN. Oriental Gas Company. Applications by Jan. 9.
OUTDOOR FOREMAN. Rhondda Gas and Water Department. Applications by Jan. 5.
LEAD BURNER. No. 5336.

Situations Wanted.

CLERK. No. 5340.
ASSISTANT OR MANAGER. No. 5337.
TAR DISTILLER OR SULPHATE MAKER. No. 5339.
AIR-GAS ENGINEER. (View to Partnership), A. G., 47, c/o Deacons, Leadenhall Street, E.C.

Stocks and Shares.

LOWESTOFT GAS AND WATER COMPANY. By Auction. Jan. 17.
SOUTHEND WATER COMPANY. By Auction. Jan. 17.
SOUTH-WEST SUBURBAN WATER COMPANY. By Auction. Jan. 17.
TENDRING HUNDRED WATER COMPANY. By Auction. Jan. 17.
YARMOUTH WATER COMPANY. By Auction. Jan. 17.

TENDERS FOR

Coal.

COPENHAGEN LIGHTING DEPARTMENT. Tenders by Jan. 14.

Condensers and Tanks.

SOWERBY BRIDGE GAS DEPARTMENT. Tenders by Jan. 23.

Fire-Clay Goods.

BURY GAS DEPARTMENT. Tenders by Jan. 12.
HEYWOOD GAS DEPARTMENT. Tenders by Jan. 14.

Elevating and Conveying Machinery, &c.

SOWERBY BRIDGE GAS DEPARTMENT. Tenders by Jan. 23.

Charging and Discharging Machinery, &c.

SOWERBY BRIDGE GAS DEPARTMENT. Tenders by Jan. 23.

Retort-House and Coal-Store, (Pulling Down and Dismantling and Rebuilding, &c.).

SOWERBY BRIDGE GAS DEPARTMENT. Tenders by Jan. 23.

Sulphate Plant.

FORFAR GAS DEPARTMENT. Tenders by Jan. 13.

TAR PRODUCTS PRICES.

Representative manufacturers give the following as fair current values for the week ending Dec. 31. Prices are net, and they include the usual packages and delivery f.o.b., f.a.s., or f.o.r., as customary.

Article.	Basis.	London.	North-East Coast.	East Coast, Yorks.	West Coast.		Glasgow.
					Liverpool.	Manchester.	
Tar crude	per ton	22/6	18/6 21/-	19/6 22/-	19/6 22/-	19/6 22/-	—
Pitch	,,	37/6	34/6	35/6	36/-	35/6	35/-
Benzol, 90 %	per gallon	-/9¼	-/8 -/9	-/8	-/7¼ -/7½	-/8	-/9
Benzol, 50-90%	,,	-/10	-/9 -/9½	-/9	-/8 -/8¼	-/8¼ -/8½	—
Toluol, 90%	,,	-/10	-/9½	-/10	-/10	-/9¾	-/10
Crude naphtha, 30%	,,	—	-/3¼ -/3½	-/3½	-/3¼ -/3½	-/3¼ -/3½	—
Light oil, 50%	,,	—	-/3½	-/3⅜ -/3⅝	-/3 -/3¼	-/3 -/3¼	—
Solvent naphtha, 90-160	,,	—	-/10½ -/11	-/10	-/10	1/-	-/10½
Heavy naphtha, 90-190	,,	—	-/11	-/11½	-/11 -/11½	-/11½	-/10½
Creosote in bulk	,,	-/2½ -/2⅝	-/2 -/2¼	-/2	-/2	-/2	-/2
Heavy oils	,,	-/3¼	-/2½ -/3	-/2¼	-/2⅝	-/2⅝ -/3	-/2⅞
Carbolic Acid, 60's	,,	1/0½	1/- 1/1	1/1	1/0½	1/0½	1/1
Naphthalene, crude drained salts	per ton	—	42/6 45/-	40/- 42/6	47/6	47/6 50/-	—
,, pressed	,,	—	60/-	63/-	60/-	60/- 72/6	—
,, whizzed	,,	—	—	—	65/- 72/6	60/- 75/-	65/-
Anthracene	per unit	-/2	-/1⅝	-/1½	-/1¼	-/1¼	—

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 17.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	Oct 14	5	Alliance & Dublin Ord.	80–83	..	6 0 6
374,000	Stk.	July 14	4	Do. 4 p.c. Deb.	95–98	..	4 1 8
200,000	5	Oct. 28	7	Bombay, Ltd.	6⅜–6¾	..	5 1 10
40,000	5	,,	7	Do. New, £4 paid	5–5¼	..	5 6 8
50,000	10	Aug. 31	15	Bournemouth Gas and Water A 10 p.c.	28½–29½	..	5 1 8
311,810	10	,,	7	Bournemouth Gas and Water B 7 p.c.	16½–16⅝	..	4 3 7
75,000	10	,,	6	Bournemouth Gas and Water Pref. 6 p.c.	14½–15½	..	3 18 8
380,000	Stk.	Aug. 12	12½	Brentford Consolidated	252–255	+2	4 18 1
330,000	,,	,,	9⅜	Do. New	193–196	..	4 16 11
50,000	,,	,,	5	Do. 5 p.c. Pref.	120–122	..	4 2 0
206,250	,,	Dec. 15	4	Do. 4 p.c. Deb.	97–99	..	4 0 10
220,000	Stk.	Aug. 31	11	Brighton & Hove Orig.	217–220	+2	5 0 0
246,320	,,	,,	8	Do. A Ord. Stk.	158–161	..	4 19 5
460,000	25	Sept. 29	10⅝	British	44–45	..	4 12 4
109,000	Stk.	Aug. 12	6	Bromley, A 5 p.c.	119–121	..	4 19 2
165,700	,,	,,	4½	Do. B 3½ p.c.	89–91	..	4 15 11
82,278	,,	,,	5½	Do. C 5 p.c.	109–111	..	4 19 1
55,000	,,	Dec. 30	3½	Do. 3½ p.c. Deb.	83–85*	..	4 2 4
250,000	Stk.	,,	4	Buenos Ayres 4 p.c. Deb.	95–97*	..	4 2 6
100,000	10	—	—	Cape Town & Dis., Ltd.	3–4	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	4½–5½	..	—
50,000	50	Nov. 2	6	Do. 6 p.c. 1st Mort.	—	..	—
100,000	Stk.	Dec. 30	4½	Do. 4½ p.c. Deb. Stk.	88–90*	..	5 0 0
157,150	Stk.	Aug. 12	5	Chester 5 p.c. Ord.	109½–111½	..	4 9 8
1,513,280	Stk.	,,	5 5/16	Commercial 4 p.c. Stk.	106–109	..	4 15 5
560,000	,,	,,	5	Do. 3½ p.c. do.	101–103	..	4 17 1
475,000	,,	Dec. 15	3	Do. 3 p.c. Deb. Stk.	77–79	..	3 15 11
800 000	Stk.	,,	4	Continental Union, Ltd.	86–91	..	4 7 11
200,000	,,	,,	7	Do. 7 p.c. Pref.	134–136	..	5 2 11
492,370	Stk.	—	5½	Derby Con. Stk.	122–124	..	4 8 9
55,000	,,	—	4	Do. Deb. Stk.	104–105	..	3 16 2
148,995	,,	Oct. 14	5	East Hull 5 p.c. Ord.	103–105	..	4 15 3
486,090	10	July 14	12	European, Ltd.	23¾–24¼	..	4 19 0
354,060	10	,,	12	Do. £7 10s. paid.	17¾–18¼	..	4 18 8
16,179,445	Stk.	Aug. 12	4⅝	Gas light and Coke 4 p.c. Ord.	105¾–106⅛	+⅛	4 7 7
2,600,000	,,	,,	3⅜	Gas light and Coke 3⅜ p.c. max.	86–88	..	3 19 7
4,062,235	,,	,,	4	Gas light and Coke 4 p.c. Con. Pref.	103–105	..	3 16 2
4,531,705	,,	Dec. 15	3	Gas light and Coke 3 p.c. Con. Deb.	73–80	..	3 15 0
258,740	Stk.	Sept. 15	5	Hastings & St. L. 3½ p.c.	93–95	..	5 5 3
82,500	,,	,,	6⅜	Do. do. 5 p.c.	114–116	..	5 12 1
70,000	10	Oct. 14	11	Hongkong & China, Ltd.	17–17½	..	6 5 8
131,070	Stk.	Sept. 15	7⅜	Ilford A and C	146–149	..	4 19 0
65,780	,,	,,	5⅜	Do. B	115–117	..	5 0 5
65,500	,,	Dec. 30	4	Do. 4 p.c. Deb.	95–98*	..	4 1 8

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
4,940,000	Stk.	Nov. 11	9	Imperial Continental	185–187	..	4 16 3
1,235,000	Stk.	Aug 12	3½	Do. 3½ p.c. Deb. Red.	94–96	..	3 12 11
200,242	Stk.	Aug. 31	6	Lea Bridge Ord. 5 p.c.	121–123	..	4 17 7
561,000	Stk.	,,	10	Liverpool United A.	220–222	..	4 10 1
718,100	,,	,,	7	Do. B	164–165	..	4 4 10
306,083	,,	Dec. 30	4	Do. Deb. Stk.	102–104*	..	3 16 11
75,000	5	Dec. 15	6	Malta & Mediterranean	4⅜–4¾	..	6 3 1
560,000	100	Oct. 1	5	Met. of 5 p.c. Deb.	100–102	+1	4 18 0
250,000	100	,,	4½	Melbourne 4½ p.c. Deb.	99–101	..	5 9 10
541,920	20	Nov. 11	3⅜	Monte Video, Ltd.	12¾–12⅞	..	5 9 10
1,775,892	Stk.	July 28	4⅜	Newc'tle & G'tesh'd Con.	101½–102½	..	4 5 4
529,435	Stk.	Dec. 30	3⅜	Do. 3½ p.c. Deb.	88–89*	..	3 18 8
55,940	10	Aug. 31	7	North Middlesex 7 p.c.	13½–14½	..	4 16 7
300,000	Stk.	Nov. 30	8	Oriental, Ltd.	137–139	..	5 15 1
60,000	5	Sept. 15	8	Ottoman, Ltd.	6¼–6⅝	..	5 18 6
31,800	53	Aug. 31	13	Portsea Island A.	132–134	..	5 2 4
60,000	50	,,	13	Do. B.	125–127	..	5 2 4
100,000	50	,,	12	Do. C.	118–120	..	5 0 0
114,800	50	,,	10	Do. D and E.	103–105	..	4 15 3
398,490	5	Oct. 28	7	Primitiva Ord.	7¼–7⅜	..	4 13 4
796,980	5	Dec. 30	5	Do. 5 p.c. Pref.	5⅜–5⅝	..	4 13 0
488,900	100	Dec. 1	4	Do. 4 p.c. Deb.	95–97	..	4 2 6
312,650	Stk.	Dec. 30	4	River Plate 4 p.c. Deb.	95–97*	..	4 2 6
250,000	10	Sept. 29	9	San Paulo, Ltd.	15⅛–15⅝	..	5 14 3
115,020	10	,,	6	Do. 6 p.c. Pref.	11¼–11¾	..	5 2 2
125,000	50	July 1	5	Do. 5 p.c. Deb.	51–52	..	4 16 2
135,000	Stk.	Aug. 31	10	Sheffield A	229–231	..	4 6 7
309,984	,,	,,	10	Do. B	229–231	..	4 6 7
523,500	,,	,,	10	Do. C	229–231	..	4 6 7
70,000	10	Oct. 14	6	South African	10⅞–11⅛	..	5 6 8
6,429,895	Stk.	Aug. 12	5/9/4	South Met., 4 p.c. Ord.	121–123	..	4 8 10
1,895,445	,,	July 14	3	Do. 3 p.c. Deb.	80–82	..	3 13 2
209,820	Stk.	Aug. 31	8	South Shields Con. Stk.	155–157	..	5 1 11
605,000	Stk.	Aug. 12	5⅜	S'th Suburb'n Ord. 5 p.c.	120–122	..	4 12 9
60,000	,,	,,	5	Do. 5 p.c. Pref.	120–122	..	4 2 0
117,058	,,	July 14	5	Do. 5 p.c. Deb. Stk.	122–124	..	4 0 8
502,310	Stk.	Nov. 11	5	Southampton Ord.	110–112	..	4 9 3
120,000	Stk.	Aug. 12	7	Tottenham A 5 p.c.	141–143	..	4 17 11
483,940	,,	,,	5⅜	Tottenham and B 3½ p.c.	113–115	..	4 15 M
149,470	,,	Dec. 15	4	Edmonton 4 p.c. Deb.	95–97	..	4 2 6
182,380	10	Dec. 30	8	Tuscan, Ltd.	8⅜–8¾*	..	8 13 0
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	98–100	..	5 0 0
236,476	Stk.	Aug. 31	5	Tynemouth, 5 p.c. max.	114–115	..	4 6 11
255,636	Stk.	Aug. 31	6⅜	Wands- B 3½ p.c.	142–144	..	4 13 7
85,766	,,	Dec. 30	3	worth 3 p.c. Deb. Stk.	73–75*	+½	4 0 0

Prices marked * are "Ex. div."